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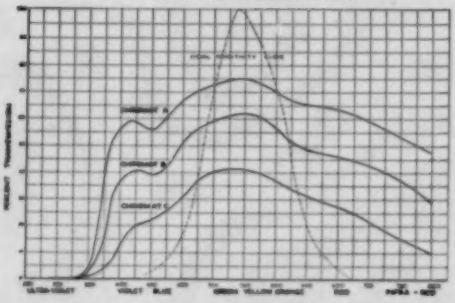

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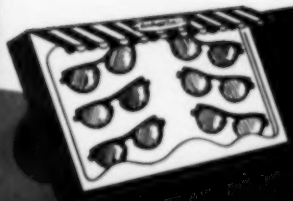

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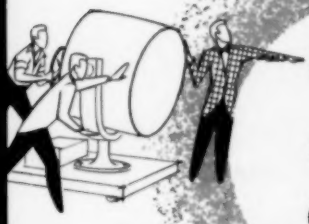

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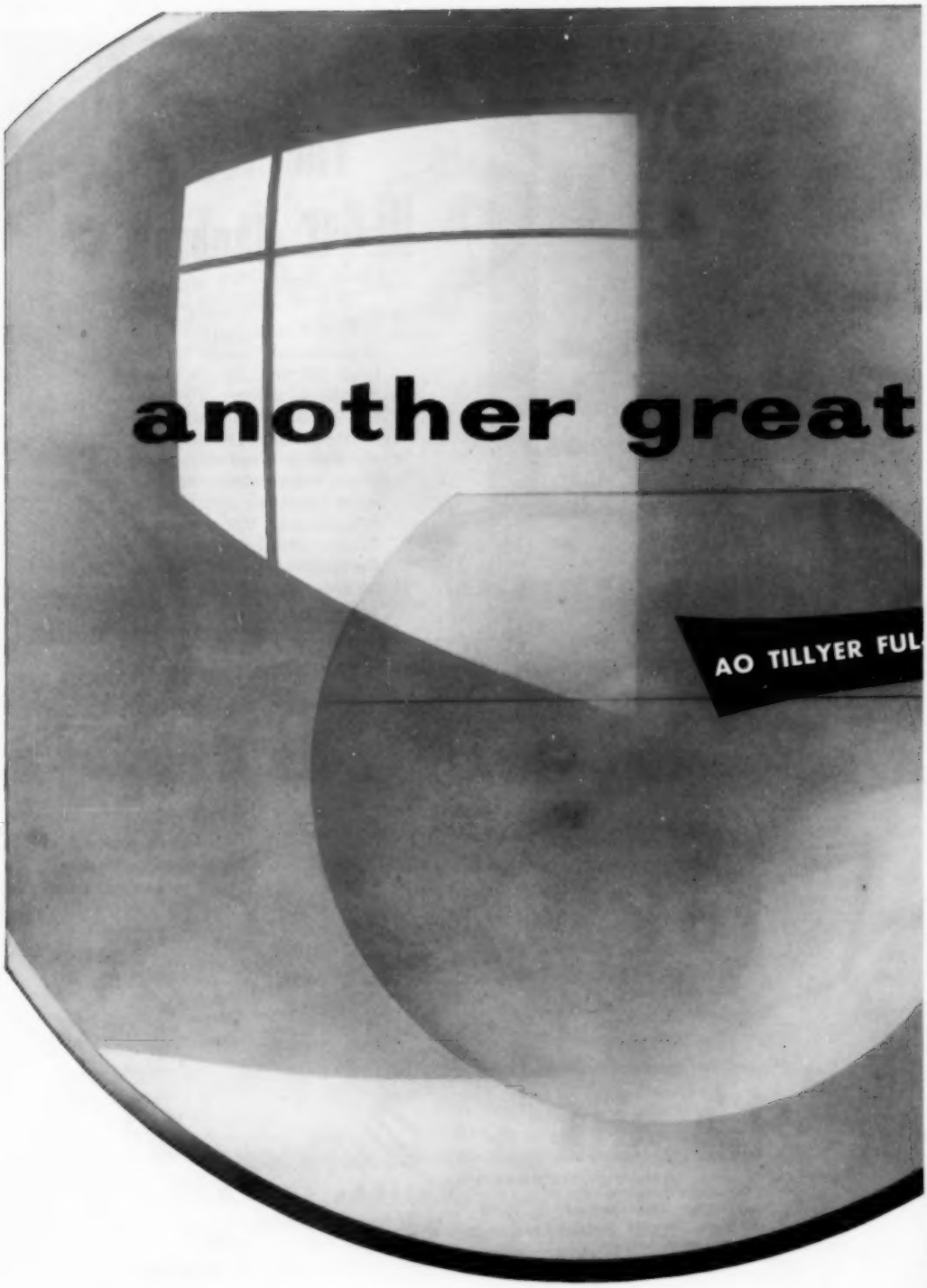
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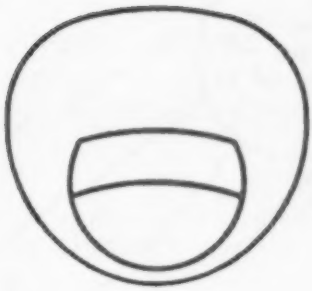

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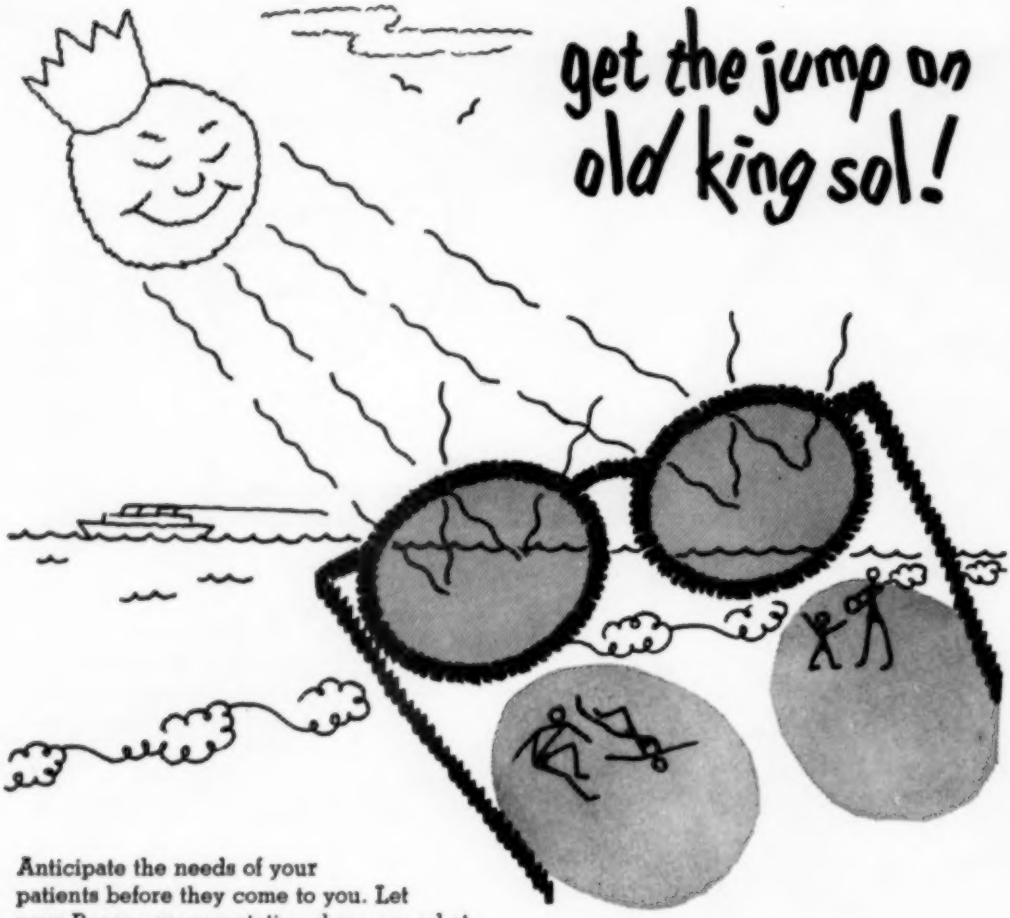

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SOME INTERRELATIONSHIPS OF AGE, REFRACTION, AND RATE OF REFRACTIVE CHANGE*

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Bloomington, Indiana

INTRODUCTION

A number of statistical studies have been made of changes of refraction and rates of changes of refraction with age. Perhaps most notable of these studies are those of Brown,[1, 2, 3] Herrnheizer,[4] and Straub.[5]

Brown[3] studied primarily the average annual rates of change of refraction from early infancy to about fifty years of age. Herrnheizer[4] made his analysis in terms of the percentage of myopes, hyperopes, and emmetropes through a wide range of age levels. Straub[5] made a longitudinal analysis for large numbers of myopes: that is, he traced the changes in refraction in each myope through several years duration. These, and many other studies, have in themselves seemed highly reliable and have for the most part served to confirm the limited conclusions drawn in each instance. However, the cross-section studies, i.e., populational averages and distributions of refractive errors at each age level, have not been entirely reconcilable with the trends and distributions that might be anticipated from the longitudinal studies, or vice versa. More specifically, the dispersion of refractive errors in the reported samples usually is shown to be reduced at certain age levels when it might be expected to increase, or at least remain constant, as a result of the changes, or the absence of changes, in refraction apparently prevalent at such age levels.

The present study, though on very limited data obtained under relatively undefinable conditions, is an attempt to analyze actual or

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*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 7, 1953. For publication in the April, 1954, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Ph.D., Director of Division. Fellow, American Academy of Optometry.

raw data in terms of their dispersions and interrelationships rather than in terms of the trends of means or averages of groups and categories. It constitutes simultaneously a longitudinal and cross-section study of a single clinical sample. Further it is an attempt to demonstrate the extent to which the theoretical trends are apparent in a sample optometric practice.

INVESTIGATION PROCEDURE

The present data were obtained from the files of the private practice of Dr. Harry Stevenson, an optometrist who has practiced in the city of Bloomington, Indiana, for approximately 50 years.

All of the clinical findings were made by the same examiner, Dr. Stevenson, employing essentially the same techniques during the period represented. The refractive procedure and the prescription in the typical case were based primarily on a rather thorough subjective determination of the refractive error. A review of the practice records indicated that lens prescriptions with therapeutic design were at a minimum, and that there was virtually no visual training or orthoptics employed which might tend to make the prescription deviate from that intended to compensate directly and fully for the subjectively determined refractive error. The clinical records were well kept and provided accurate information as to age, dates of examination, and prescription details. The patients as a group represented a fair sampling of rural and urban optometric patients including numbers of agricultural, industrial, academic, clerical, and business personnel. The age and sex distribution of patients compared favorably to that of a previously reported sample optometric practice believed to be typical.[6]

Data were taken only from current records of patients examined at least twice on separate visits. Findings from only the first two visits were included when the record showed more than two examinations. Only records representing the full refractive examination of both eyes on both visits were used. No further selection was made except when notation on the record form indicated doubt as to the accuracy of the correction prescribed, in which instances these data were not included. Altogether 579 patients were represented.

The following findings were taken or computed from the records:

1. Age reported by patient at first examination.
2. Number of months between first and second examination.
3. Lenses prescribed at first examination.
4. Lenses prescribed at second examination.

From these findings the following additional computations were made:

1. The age of each patient midway between the two examinations.

2. The mean spherical equivalent refractive error of both eyes at the time of each examination, assuming the prescribed lenses to represent the refractive error. For example, the prescription O.D. $+0.75 = -0.50 \times 180$, O.S. $+0.25 = -1.00 \times 180$ would represent a mean spherical equivalent refractive error of $+0.125$ diopters.

3. The monthly rate of change of the mean spherical equivalent refractive error. This was obtained by subtracting the mean spherical refractive error of the first examination from that of the second examination and dividing by the number of months between the two examinations. Thus a patient becoming more myopic, or less hyperopic, would show a minus (—) rate of change, while one becoming less myopic, or more hyperopic, would show a plus (+) rate of change.

RESULTS

The results are shown in Figures 1-6.

The lengths of the intervals between examinations are represented in Figure 1. The mode is a period slightly less than three years. The mean is nearer four years. It is significant in this study that less than one per cent of the intervals were under a half year, since short intervals combined with normal measurement errors would produce apparently extreme rates of change. A possible example of this is the isolated high value in the upper central region of Figure 4, a patient examined twice in a nine month interval and showing a change in prescription of approximately a half diopter of increase in plus sphere. The extremely

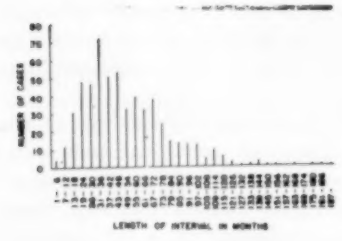

Fig. 1

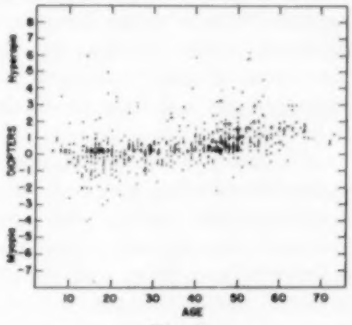

Fig. 2

Fig. 1. Frequency distribution of all 579 patients in terms of the length of interval between first and second examinations.

Fig. 2. Scatterplot of all 579 patients, showing the incidence and distribution of mean spherical equivalent refractive errors throughout the range of age levels. The age and refraction are for the first examinations only.

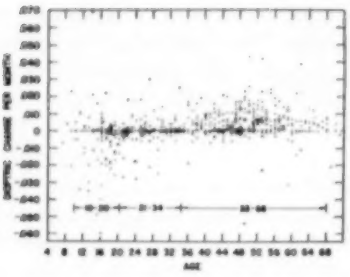

Fig. 3

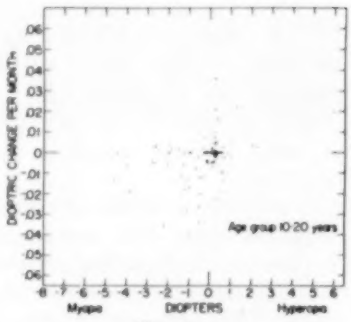

Fig. 4

Fig. 3. Scatterplot of all 579 patients, showing the incidence and distribution of rates of change in refraction throughout the range of age levels. The minus (−) diopters per month are changes in the direction of less hyperopia or more myopia; etc. The abscissa values represent the ages at the midpoints of the interval between the two examinations.

Fig. 4. Scatterplot of the patients in the age group 10 to 20 years inclusive, showing the monthly rates of change in refraction between the first and second examinations in relation to the refractive errors manifested at the time of the first examinations. The minus (−) diopters per month are changes in the direction of less hyperopia or more myopia; etc.

long intervals on the other hand present another objectionable feature, namely that of depreciating the rapid rates of change that might have occurred during only a part of the interval. Considering the lengths of intervals actually involved, it therefore must be borne in mind that the apparent rates of change obtained here must be characteristically less than the true values that would be obtained if individual cases were examined at frequent intervals over a long period. This may explain the more extreme rates of changes obtained by Brown[3] at comparable age levels, though he did not report the actual lengths of intervals employed in his survey.

A factor which could not be given adequate evaluation in this study was whether or not the rate of change in individual cases served to influence the length of the interval, which is to suggest that patients with slow rates of change might not submit themselves to reexamination as frequently as those with rapid rates of change. It is not apparent, however, that this factor, if present, would affect the restricted conclusions to be drawn from this report.

The mean spherical equivalent refractive errors at the various age levels are shown in Figure 2. Starting with the youngest subjects, it is interesting to note that the few cases between six and nine years of age show the expected predominance of hyperopia for this age

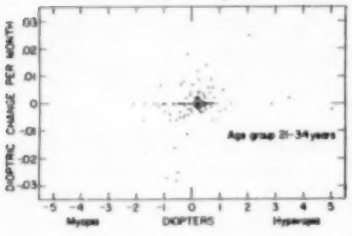

Fig. 5

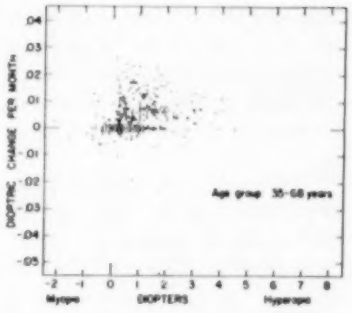

Fig. 6

Fig. 5. Scatterplot of the patients in the age group 21 to 34 years inclusive, showing the monthly rates of change in refraction between the first and second examinations in relation to the refractive error manifested at the time of the first examination. The minus (—) diopters per month are changes in the direction of less hyperopia or more myopia; etc. The encircled numerical value in the center represents a group of points too densely aggregated to plot individually.

Fig. 6. Scatterplot of the patients in the age group 36 to 68 years inclusive, showing the monthly rates of change in refraction between the first and second examinations in relation to the refractive errors manifested at the time of the first examinations. The minus (—) diopters per month are changes in the direction of less hyperopia or more myopia; etc. The enclosed numerical values represent groups of points too densely aggregated to plot individually.

level. The widest dispersion of refractive errors is obtained in the next twelve years, with a slight assymmetry of distribution toward myopia, but with the mode at approximately a quarter diopter of hyperopia. The next decade, approximately 22 to 32 years, represents a small sample, but it is nevertheless apparent that the dispersion is reduced and that the distribution is reasonably symmetrical, with the peak of the distribution only slightly on the hyperopic side of emmetropia. From about age 33 to 66 the drift of the data continues gradually toward hyperopia although the mode itself seems to shift rather suddenly at age 50. In this same period the distribution changes from one of symmetry to one of assymmetry toward hyperopia. The few cases above 66 years are insufficient to indicate a trend, but it is interesting to note that they suggest a rapid reversal toward myopia.

In Figure 3 the results are plotted as monthly rates of change throughout the range of age levels. Inspection of the figure suggests that the age range may be divided conveniently into three portions for separate analyses, these divisions being selected on the basis of the varying distributions of the data. In the age range 10-20 years inclusive the mode is at zero, indicating a significant share of patients who show no changes in refraction at all. Excluding these cases, however, the

majority show rapid changes toward myopia or reduced hyperopia. In the age range 21 to 34 years inclusive both the mean and the mode of the distribution are near zero. In the age range 35 to 68 years inclusive the mode persists near or at zero, but the great majority of cases show increase in hyperopia or decrease in myopia throughout the 34 year period.

An apparent statistical paradox manifests itself in the comparison of Figures 2 and 3. The rate of change toward myopia is greatest during the adolescent period, yet there appear to be fewer myopes immediately following this period. The remainder of the data do not show this paradox. In the intermediate age range both the average rate of change and the average degree of refraction remain relatively constant. Above the age of 34 the change is in the direction of hyperopia with a continuously increasing average hyperopia throughout the entire period.

These observations naturally raise the question as to which refractive groups are manifesting the changes. This analysis for the 10-20 year age group is represented in Figure 4 in which the rate of change is plotted against the refractive error.

In this figure there appear to be two reasonably distinct types of distribution with a dividing or transition line in the neighborhood of —0.25 to zero diopters of myopia. To the left of this abscissa value there are no significant changes toward hyperopia or reduction of myopia. Among the myopes between —0.25 and —2.25 there are extremely rapid rates of change. To the right of the transition zone the distribution of rates of change is practically normal, with the mean and mode at or near zero. This remarkable transformation in distribution suggests that when a refractive error in an adolescent falls just below —0.25 D. a sudden increase in the rate of change occurs from which recovery appears unlikely.

There is not a sufficient number of cases below —2.25 to show whether or not this high rate persists as the myopia continues its development beyond that level, but the few cases shown suggest that the rate levels off somewhat after the initially wide dispersion below —0.25. That this latter leveling off, if real, is not due to an arresting of the change with approaching maturity is supported by the fact that the average age of the eight cases of myopia in excess of —2.25 was almost identical to the average age of the whole group reported in Figure 4.

A similar analysis for the age group 21-34 years is presented in Figure 5. A casual inspection suggests a simple positive correlation between refractive error and rate of change. Closer examination, however,

shows a rapid change of the distribution pattern on the myopia side of zero, similar to the pattern exhibited in Figure 4. The centrally located data show no significant correlation between refractive error and rate of change. The few cases at the higher hyperopia levels resemble the distribution presented in Figure 6.

Figure 6 represents the scatterplot for the age range 36-68 years. The sudden increase in rate of change toward more myopia exhibited in Figures 4 and 5 is absent here. The distribution shows a pronounced skewness with a mode at zero rate of change, with most of the extramodal cases showing a rate of change toward more hyperopia or less myopia. The mode at zero begins to disappear, however, above the +1.00 diopter level. Above the +2.00 diopter level a continuous change of about .005 diopters per month toward more hyperopia seems generally prevalent in this age group.

DISCUSSION

The data from this limited sample of cases follow in general the same trends with age shown by the data of previous investigators, though the trends are not as pronounced. These quantitative differences are probably reasonable in view of differences in test procedure, refraction criteria, and lengths of intervals between examinations. Accordingly the present data cannot be considered to contribute toward the establishment of true populational tendencies.

The apparent paradoxes observed in the comparison of previous data analyzed independently by longitudinal and cross-section methods, and similar paradoxes observed in the present single sample, are undoubtedly due to uncontrolled selection processes determining the types of patients presenting themselves for ophthalmic services in clinics and offices. Thus the relatively high frequency of myopes among the adolescent patients may well be due to the failure of adolescent hyperopes to present themselves for clinical services. The relative drop in frequency of myopes in the post-adolescent age range may in turn be due to the possibility that myopes are less disturbed by the effects of lowering amplitudes of accommodation with increasing years.

Whatever the factors, and there are certainly many, it is evident that the surveys of refractive trends based on cross-sectional analyses of clinical patients in different age groups cannot indicate with any known degree of validity the true trends of the general population or even of the individual clinical patient. The longitudinal studies on the other hand do offer some indications of the trend of at least the individual clinical patients, if not of the general population.

The principal problem posed by the results reported here is that

concerned with the apparently rapid rate of myopia increase among the low myopes in the adolescent age levels. The problem is both of theoretical and practical interest. The relative absence of high rates of change among those immediately above the emmetropia level as compared to the predominantly high rate of change immediately below the emmetropia level hints at the possibility that the presence of myopia itself is a factor related to the rate of change. It is of course realized that the rate of change simultaneously manifests itself in the production of myopia. This obvious fact only confounds the problem, for if it were as simple as this the rates of change among the hyperopes closely approaching myopia should be just as great as the rates of change among the myopes themselves. If not the same, the transition should at least be more gradual.

There is not ruled out in this study the possibility that the self-selection process among clinical patients contributes to a distortion in the longitudinal analysis also. Accordingly it may be postulated that young hyperopes of low degree showing rapid reduction in hyperopia ordinarily would not present themselves for optometric care until their refractions had made the transition into myopia. Hence in an analysis like this they would appear only subsequently as rapidly increasing myopes of low degree. Similarly it may be postulated that myopes manifesting reduction in myopia would be less likely to present themselves for optometric service, thus to account for the paucity of data in the upper left regions of Figures 4 and 5.

Such considerations can be supported, however, only by the assumption that the mean spherical equivalent refractive error is a predominant basis for the patients' decisions to seek optometric service. This assumption is largely contra-indicated in the present survey, first, by the fact that the statistical mode of refractive errors consistently clings near zero (See Figure2), and, second, by the generally recognized prevalence of so many clinical factors unrelated to the mean spherical equivalent refractive error.

The concept of myopia begetting myopia is not entirely new. Straub's[5] longitudinal study of myopes led him to believe that "fully-corrected" myopes showed less subsequent increase in myopia than "under-corrected" myopes. His results would carry the practical implications even farther than the findings reported here, since his evidence was related, not just to the presence or absence of myopia, but rather to the presence or absence of a full minus correction.

The increasingly prevalent tendency toward increased hyperopia in the years of later maturity is in accord with popular clinical beliefs.

The tendency does not seem to bear any relationship to the type or degree of refractive error present. The relative constancy of the rate of change throughout the three decades of life represented in Figure 6 suggests that it is not related to the onset of presbyopia, since the onset of presbyopia, however defined, confines itself for the most part to a much smaller range of years.

SUMMARY

A study is made of refractive changes shown in 579 case records taken from the files of a practicing optometrist. Each of the patients had been examined at least twice. The data are analyzed in terms of (1) refractive error and age, (2) rate of change of refractive error and age, and (3) relationship of refractive error to rate of change of refractive error at selected age levels.

The results indicate that cross-section studies of the refractive error among clinical patients do not reflect the true trends in individual clinical patients, that the rate of change of refractive error among adolescents seems remarkably related to the presence of myopia itself, and that the rate of change of refractive error among older adults is relatively constant throughout the later years and unrelated to the type of refractive error present.

Practical and theoretical implications of these results are discussed. The possibility that the self-selection process in clinical samples may distort the longitudinal studies based upon such data has not been ruled out.

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A CONSIDERATION OF CONVERGENCE AND DIVERGENCE ANOMALIES*

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During the last twenty years there has been a decided increase in the interest of optometrists in the field of orthoptics and visual training. It is the purpose of this paper to review some of the pertinent ophthalmological literature which is directly applicable to the field of visual training, not including the broad subject of heterotropias. At the meeting of the Orthoptics Section, American Academy of Optometry in 1950, Dr. Max Schapero summarized the prevalent theories dealing with the diagnosis and correction of heterotropia. He pointed out the confusion which existed and many of the apparently contradictory viewpoints. It is the purpose of this paper to perform a similar function for the Section on Orthoptics in the field of convergence and divergence anomalies as described by ophthalmological sources. I am limiting my material to the ophthalmological sources because I feel that optometrists in general may not be as familiar with these viewpoints and this will also enable me to handle the subject without undue confusion resulting from an unduly lengthy presentation.

The terms most commonly encountered in the literature are:

1. divergence excess
2. divergence insufficiency
3. convergence insufficiency
4. convergence excess.

There is some disagreement among authors as to what constitutes an adequate differentiation between the various conditions.

We shall first discuss divergence excess:

One of the earlier references to divergence excess appears in the writing of Duane[1] (1897). Duane used the term divergence to apply only at the six meter fixation distance and used it to describe either an eso or exo situation. Divergence excess was a condition characterized by an unusually high exophoria at infinity with no near point characteristics

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necessary for the diagnosis. This condition could actually be an exophoria, an intermittent, or constant exotropia.

This view is embraced by Krimsky[2] and his diagnosis is symbolized by the following:

Divergence excess—for the far (or 20 foot) range.—Divergence excess is a loose general term to indicate either an abnormal exophoria or an actual manifest divergent squint (exotropia) when the eyes are directed to a far point of say 20 feet. Deviation is not the sole consideration in establishing the nature of divergence excess. The fusion amplitude (prism convergence and prism divergence) may or may not be sufficient to counteract the deviation.

Divergence excess with abnormal exophoria—for 20 feet in primary position.—CHARACTERISTIC FEATURES.—(1) Symptoms.—Usually absent; occasional ocular discomfort; (2) Status for far. (a) Binocular fixation and fixational corneal light reflexes for far; (b) an appreciable exophoria of more than 5Δ often suggests slight or moderate divergence excess unless there is sufficient counteracting prism convergence. Prism convergence reading should exceed the value of the exophoria. (Normal phoria response for far is orthophoria or slight esophoria.) (3) Status at 13 inches.—Binocular response for 13 inch range—may or may not be normal; (4) Near-point. Convergence near point may or may not be normal; (5) Treatment—refractive correction does not usually improve imbalance.

It will be noted that Krimsky earlier speaks of divergence excess being a condition dependent on distance fixation, but actually he uses a number of near point characteristics in his analysis.

The views of Krimsky are not in agreement with a number of other authors. The confusion existing may be illustrated by the following statement of Costenbader.[3]

The fourth question comes home to us more often at a clinical level. "What is 'divergence excess,' and how shall it be defined?" Some synonyms for the term would seem to be occasional exotropia (Pugh), neuropathic exotropia (Worth), periodic exotropia (Bielschowsky), and intermittent exotropia. It would seem that some of these terms would be preferable, because implicit in the term "divergence excess" is the thought that divergence is active and that an increased diverging power is present in the condition. This has not been proved and until so should not be implied.

Bielschowsky feels that "divergence excess" is rare but that a divergent position of rest is not uncommon. Bruce describes "divergence excess" as "that condition in which one finds hyperkinesis of divergence." Sugar conservatively speaks of the "divergence excess" type of exotropia, giving as characteristics the following—exophoria or tropia greater at distance than near, good vision in each eye, suppression when manifest, and fusion when latent, and increased prism divergence, for distance particularly. Pugh states, "This group (divergence excess) appears to be apart, and it is tempting to regard it as a primitive group wherein the person can use binocular vision when required, but does not always do so." Healy, quoting Berens, Hardy, and Stark, gives a comprehensive definition of "divergence excess" as "that ocular muscle imbalance exhibiting an exophoria more marked when the gaze is directed into the distance than when it is adjusted for near vision, combined with normal prism convergence and normal near point of convergence, and an excessive ability to overcome diplopia caused by prisms base-in before the eyes. The lateral movements of each eye should be normal and comitant."

Further evidence for the existence of confusion is to be found in the following quotation from Scobee.[4]

There are four terms widely used in ophthalmology which invariably confuse the student in his first contact with them. They are: (1) convergence insufficiency, (2) convergence excess, (3) divergence insufficiency, and (4) divergence excess. The student's confusion arises not so much over the terms per se, but over the many contradictory meanings given them by various writers.

There is no single set of definitions which might be considered classical. One set of definitions is as follows:

(1) Convergence insufficiency—if there is either esophoria or esotropia; and it is greater at far than at near, there is convergence insufficiency.

(2) Convergence excess—if there is either esophoria or esotropia, and it is greater at near than at far, there is convergence excess.

(3) Divergence insufficiency—if there is either exophoria or exotropia, and it is greater at near than at far, there is divergence insufficiency.

(4) Divergence excess—if there is either exophoria or exotropia, and it is greater at far than at near, there is divergence excess.

The basis of the above classification is that any exophoria or exotropia is an anomaly of divergence, while any esophoria or esotropia is an anomaly of convergence. The confusion extant becomes apparent when one turns to Duke-Elder (1928), who in speaking about exophoria wrote that ". . . where the divergence is actually in excess, the defect is greater for distant than for near vision. On the other hand it may be due to an insufficiency or convergence." And in speaking about esophoria, he wrote that ". . . it may be due to divergence insufficiency, in which case it is more marked for distant vision than for near. Usually it is due to an excess of convergence." It is apparent that Duke-Elder is of the opinion that in many instances divergence excess and convergence insufficiency are one and the same; similarly, divergence insufficiency and convergence excess may also be the same.

One more definition for divergence excess may be included from the Lyle Edition of Worth & Chavasse[5] since their concepts are widely accepted.

Exophoria (b) Divergence excess type (showing a deviation for distant vision as large as, or larger than, that for near vision).

All of the aforementioned quotations at least agree in one fundamental, namely, that the condition is characterized by an exophoria at infinity with a concommitant high prism divergence. This point was demonstrated in a series of patients by the author as an illustration of the tonic nature of the heterophoria in these moderate to high exophoric cases.[6] The use of this material to simplify terminology will be suggested later in this paper.

The next term to be considered is divergence insufficiency. In examining the literature on this subject we may again begin with the writings of Duane. As in the previous instance, Duane suggested the use of the term be restricted to fixation at infinity. The term would denote a condition of esophoria or esotropia with fixation at infinity In the case of divergence insufficiency, the near point findings would not be a factor since the divergence effects are all a function of distance fixation.

Krimsky tends to follow this same general classification as can be illustrated by the following:

Disturbances for the far range.—Divergence insufficiency.—Divergence insufficiency is a loose general term to indicate abnormal esophoria or esotropia when the eyes are directed to a far point of say 20 feet or more. The term "abnormal esophoria" is used to indicate not necessarily a marked esophoria but one in which the counteracting or opposing prism divergence is relatively poor.

Deviation is not the sole criterion for interpreting the condition as divergence insufficiency. The dynamic status as embodied in prism convergence and prism divergence serves as a flexible balance for keeping the eyes normally steady for binocular requirements. An abnormal disproportion between prism convergence and prism divergence

tends to draw the visual axis in one direction or the other depending on which phase of the fusion amplitude range is top heavy.

The term divergence insufficiency should indicate whether it is associated with an abnormal esophoria or with a manifest esotropia.

Divergence insufficiency with abnormal esophoria—for 20 foot range in primary position.—FEATURES.—(a) Symptoms.—There is often asthenopia or ocular discomfort especially far.

(b) Status for far.—(1) Binocular fixation for 20 feet; (2) esophoria usually greater than 4Δ or 5Δ; and yet in certain instances there may be sufficient compensating prism divergence (base-in prism) to make one question the diagnosis of divergence insufficiency. Esophoria alone does not form the basis for final diagnosis; (3) prism convergence and prism divergence relationship disturbed. Prism convergence relatively increased. Normally, prism convergence is about two or three times prism divergence at the 20 foot range.

(c) Status for 13 inches.—(1) binocular status for 13 inches may or may not be normal. Disturbance for far range does not usually influence near range.

(d) Near-point.—Convergence near-point may or may not be normal.

(e) Differential diagnosis.—In relative suppression, maintenance of single vision with rotation of prism simulates prism divergence and normal response. In such instances, observe the eyes and the maintenance of the fixational corneal light reflexes to base-in prism.

(f) Treatment.—Refractive correction does not usually improve status.

This quotation illustrates the fact that Krimsky diagnoses divergence insufficiency by using some near point criteria and prism vergence findings even though his general approach is in accordance with the pattern suggested by Duane.

A clinical study of divergence insufficiency was presented by Prangen and Koch.[7] The description of the condition which was used as a criterion for placing patients in this category is essentially as follows:

Divergence insufficiency is distinguished from other types of esophoria by the fact that in the former condition the esophoria is greater in distance vision than it is in near vision and the power of divergence or abduction is definitely less than normal. These cases may be further divided into those in which there are insufficiency, paresis, and paralysis, the differentiation here being more a matter of degree of severity, clinically, of the divergence difficulty. A similar classification is used clinically to describe various degrees of accommodative weakness. Embarrassment of divergence varies from a low grade insufficiency to an actual paralysis of the function.

A study of the above quotation reveals the use of near point findings in conjunction with the heterophoric and vergence findings with fixation at infinity. This differs from the viewpoint of Duane and somewhat from that expressed by Krimsky.

The viewpoint of Scobee is indicated by the following quotation:

Divergence insufficiency is usually manifested by subnormal prism divergence, normal or excessive prism convergence, and a normal NPC. There may be exophoria or exotropia but more commonly esophoria or esotropia.

In summarizing ideas about the anomalies of vergence—of convergence and divergence—it is not enough to know whether the deviation is exo- or eso. One must know the prism convergence and prism divergence (fusional amplitudes). Use of the terms divergence excess and insufficiency implies acceptance of the concept of divergence being an active rather than a passive process. If one believes that divergence is merely passive, then convergence and insufficiency are all that need be named.

The above quotation indicates a general agreement with the viewpoint of Prangen & Koch with the added factor of a normal near point

of convergence. This concept is not contradictory to the writings of Prangen & Koch since they tacitly admit this point when they say that convergence is normal.

The viewpoint of Prangen & Koch is practically the same as that of Worth & Chavasse when they use the term divergence weakness in relation to a concommitant esophoria. They say little about the prism vergence findings either with fixation at infinity or at near.

With respect to the convergence terms we shall first consider the term convergence insufficiency. To illustrate the confusion existing in the definition of this term, we might start with two quotations from Scobee[8] which are placed only one page apart. He states: "Convergence Insufficiency—if there is either esophoria or esotropia and it is greater at far than at near—there is convergence insufficiency." On the following page we obtain an entirely different picture of the condition as the following quotation indicates:

> Convergence insufficiency is usually manifested by exophoria, normal or excessive prisms divergence at near or far, subnormal prism convergence at near or far, and the NPC may be normal or remote. The patient with an extreme of convergence insufficiency may also be nervous and tense, but from an entirely different cause; the problem here is one of constantly whipping a convergence mechanism into excessive action and a constant struggle is a fatiguing and nerve-racking affair. The patient with convergence insufficiency will, on the average, develop symptoms far sooner after beginning close work than will the patient with convergence excess.

A description of convergence insufficiency which is more in agreement with the many other authors writing on the subject is that of Cushman & Burri.[9] They suggest, in their report on 80 patients with convergence insufficiency, that the criterion for their diagnosis consisted of several possibilities. Cushman and Burri selected patients who had more exophoria for near fixation than for distance fixation or as a second possibility an exophoria for near fixation with orthophoria for distance. These heterophoric situations were present with adduction weakness (low prism convergence and low positive relative convergence) or a poor balance between the positive and negative vergence findings. A third group included in their survey was composed of those who had no exophoria but simply a poor balance between the positive and negative vergence findings. No patients were considered as having a convergence insufficiency unless subjective symptoms were present after a proper refractive correction. This last criterion cannot be overemphasized in any discussion or diagnosis of the convergence instabilities.

Duke-Elder's[10] suggestions for diagnosing convergence insufficiency are as follows:

> The diagnosis of convergence insufficiency is usually easy. Without any limitation of lateral adduction the eyes fail to converge fully, and on looking at a near object one eye only appears to make up fixation: actually both eyes converge equally, but the in-turning is associated with a conjugate movement to one side augmenting the in-turning of the fixing eye and neutralizing that of the other. The diagnosis is

based on the presence of orthophoria in the distance, the periodic increase of divergence as the near-point is approached (e.g., orthophoria with the Maddox rod at 6 metres and exophoria of 6° or more with the Maddox wing), the remoteness of the near-point (beyond 9.5 cm.), the low prism convergence (below 8°) and normal prism divergence. The enlargement of the pupil when the near-point is reached despite the continued approach of the object is striking. It is to be distinguished from static exophoria wherein the deviation is relatively constant for all distance, and from divergence excess wherein the divergence is greatest in the distance and diminishes as the fixation point approaches the eyes, the near point of convergence is normal, the prism convergence is normal and the prism divergence is abnormally great.

Here we note the careful inclusion of the poor convergence near point or early break on the push up of convergence test. This criterion is not mentioned by either Cushman and Burri or Scobee. In using the prism vergence findings and the heterophoric relationships as diagnostic signs, the authors quoted are in relative agreement. In describing convergence insufficiency it should be mentioned that all the authors mention the high percentage of neurotic patients among this group. This has been found by the present author in clinical practice. The neurotic nature of the insufficiency possibly also accounts for the glowing praise and apparent improvement in patients undergoing orthoptics for these conditions when little change can sometimes be ascertained in the objective findings.

The last term to be considered is convergence excess. In surveying the literature on this subject one is again impressed by the influence of the writings of Duane. As previously recorded in this article he considers convergence anomalies directly in conjunction with near fixation. Thus convergence excess becomes essentially esophoria for a near fixation point.

The concept of Duane, which uses esophoria as the criterion, is enlarged by Krimsky to include the prism convergence and prism divergence relationships for near fixation.

A diagnosis of convergence excess with esophoria does not mean much without consideration of the dynamic picture as well. Also, the status in the primary position may be different from that found in secondary positions.

CHARACTERISTIC FEATURES.—1. Symptoms of asthenopia and ocular discomfort—not uncommon.

2. Binocular status for far—may not be normal.

3. Status at 13 inches—binocular fixation, apparently good for near; and fixational corneal light reflexes in both eyes.

Appreciable esophoria at the near-range, usually accompanied by limited prism divergence as compared to prism convergence.

If associated with hyperopia, there may be immediate reduction in esophoria and increased prism divergence with plus lenses.

Near-point—may or may not be normal or excessive.

The above quotation from Krimsky relates the relative convergence findings to the concept of convergence excess as well as including a special reference to the role of uncorrected hyperopia in the management of the convergence excess situation.

Further examination of the literature on convergence excess would

include the diagnostic evaluation from the Lyle's Edition of Worth & Chavasse.

(2) Esophoria (a) convergence excess type (showing a deviation for near vision as large as or larger than, that obtained for distant vision).

Here again the diagnosis is made on the basis of the heterophoria without the inclusion of the prism vergence findings. This follows more closely the definition of Duane. Duane's concept considers only the near point heterophoria with no diagnostic role for the relative convergence findings.

The viewpoint of Duke-Elder is closely related to that of Krimsky except that Duke-Elder considers the distant heterophoria as well as the near heterophoria.

The diagnosis is usually relatively easy, and depends essentially on the marked increase of esophoria at the near-point, which gradually disappears to become negligible at 6 metres. The prism convergence is increased, and the prism divergence is normal, while all lateral movements with each eye are unaffected even in the most pronounced spasmodic conditions.

Scobee describes convergence excess as follows:

Convergence excess is usually manifested by esophoria, excessive prism convergence at near or far, often subnormal prism divergence at near or far, and the NPC is usually good. It is no coincidence that the patient with convergence excess is frequently a tense and nervous type, since his chief problem is an attempt to inhibit convergence and to relax.

The above quotation demonstrates the similarity of the viewpoints of Scobee and of Duke-Elder, regarding convergence excess. There is less difference of opinion on the diagnostic criteria of convergence excess than some of the other related conditions.

The foregoing quotations have demonstrated the points of agreement and disagreement of a cross section of modern ophthalmological writers on the subject of convergence anomalies. Since there is considerable confusion on the subject I would like to suggest a more unified manner of viewing these anomalies.

In the quotations and writings which we have considered there has been some discussion of the necessity for postulating the existence of a divergence center as well as a convergence center. I agree with the following viewpoint of Scobee:

The existence of a center for ocular convergence in the brain is well established (Riley, 1930). Evidence for the existence of a separate center for ocular divergence, presented by Bruce (1935), is much less convincing. The convergence center has been located anatomically by Bender and Weinstein (1943), but no anatomic location has ever been demonstrated for a divergence center.

The same concept is expressed by Burian.[11] Furthermore, it is not essential to consider a divergence center in order to account for the various clinical pictures given by these four classifications.

Using the framework of graphic analysis,[12] it can readily be seen that only two possible variations of convergence can occur. Either the

zone of clear single binocular vision will move to the right, or it will move to the left. Considering only the movements to the left (most movements to the right can be explained as accommodative variations) there are three possibilities which must be considered.

(A) A movement of the field of clear single binocular vision to the left at infinity with a normal relative convergence balance at near.

This will occur when the tonic position (primary position) of rest is in a divergent (exophoric) position. Here, an increase of the prism divergence finding over that normally expected[6] will be noted. The near point findings are in normal balance and the near point of convergence is satisfactory.

This anomaly could be named a *Tonic Convergence Insufficiency*. The situation could be likened to a runner of exceptional speed who must run the 100 yard dash from a point behind the starting line but who is still capable of finishing with the other runners who started at the regular position. The exophoria is a handicap imposed on the convergence function, but it is overcome by a strong convergence ability, and thus the near point findings are adequate. It is conceivable that this condition could also occur with a normal or weakened convergence ability, thus creating a distortion of the near point findings to the left and possibly even a poor near point of convergence.

(B) A movement of the field of clear single binocular vision to the left (NRC larger than PRC) at the near point with a normal set of values on the base line (infinity position).

This relationship indicates a *Functional Convergence Insufficiency* which is frequently accompanied by a poor near point of convergence. This condition is not dependent on a faulty tonic position of rest but is rather a functional insufficiency.

Here we are dealing with a loss of convergence ability (Scobee calls it hypokinetic convergence) associated with a normal (orthophoric) starting point. This condition would be very similar to what formerly has been termed convergence insufficiency. The syndrome could be termed a *functional convergence insufficiency* and would occur with or without a normal near point of convergence. A functional convergence insufficiency could also occur in conjunction with the tonic convergence insufficiency.

(C) A lowering of the fusional (prism vergence) findings in all directions, thus a narrowing of the field of clear single binocular vision.

Here we are dealing with a weak fusional sense, either inate or produced by neurasthenia, convalescence, reduced visual acuity in one or both eyes, debilitation, hyperphoria or aniseikonia.

This *fusional convergence insufficiency* would be marked by unstable prism vergence findings and a lowered vertical fusion range.

Fundamentally, we could therefore include:

A. tonic convergence insufficiency
B. functional convergence insufficiency
C. fusional convergence insufficiency.

The three subdivisions of convergence anomalies are interrelated in that the tonic position of rest (fixation at infinity) defines the starting point for convergence. This starting point may be esophoria, orthophoria, or exophoria. Superimposed on this starting point we may have a supranormal, normal, or subnormal (hypo or hyperkinetic) convergence ability. This will result in all of the possibilities outlined in the earlier portions of this paper.

If the effects of a functional esophoria (caused by an accommodative spasm producing convergence through A-C, or a hypertensive stimulation of convergence of neurogenic origin) be considered, movements of the field of clear single binocular vision to the right may be fitted into the scheme. The accommodative and hypertensive stimuli may also be divided into tonic, functional, and absolute components. It was the purpose of this paper to deal only with the convergence anomalies, but a word about the other possibilities would be in order.

The net result of these functional influences would be to produce a more esophoric situation. If an accommodative spasm is reflexy stimulating positive convergence, then a tonic exophoria, orthophoria, or esophoria would be modified by some movement of the visual axes in a positive direction. This movement of the visual axes in a positive direction will not modify the prism divergence findings[6] but will have a tendency to increase the prism convergence values. Relief of the accommodative spasm will allow the convergence to relax and the heterophoria readings will revert to the basic tonic level.

A second possibility occurs in physiological esophoria, where a normal accommodative change creates an excessive convergence response. This may result from a neuropathic source or from a very high A-C relationship, and is similar to the convergence excess type of case. In any event this condition has a poor visual training prognosis.

SUMMARY

The paper demonstrates the marked variance of ophthalmologic opinion on the question of what constitutes:

1. divergence excess
2. divergence insufficiency

3. convergence insufficiency
4. convergence excess.

Since there is considerable difference of opinion, a simplified method of considering these anomalies is suggested. This method consists of assuming a variable starting point (distant heterophoria) and combining it with the possibilities of supranormal, normal, and subnormal abilities of the convergence function. This concept, when combined with the effects of accommodative variations upon convergence, includes all the possibilities and unifies the concepts. The question of whether one variation precedes the other is academic and need not be considered clinically. It is the intention of the author to write a subsequent paper dealing with the treatment and prognosis of these anomalies.

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A SYSTEM OF COMMUNICATION IN OCCUPATIONAL OPTOMETRY*

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PREFATORY COMMENT

Communication. Def.: "Interchange of thoughts or opinions, by conference or other means; correspondence." Webster.

This simple concept whereby man transmits his knowledge or information to other men is often abused or neglected in optometry, as perhaps in other fields. But it is a costly mistake to do and one which can be eliminated readily.

After years of lecturing on the subject of occupational vision, this writer has noted a constant recurring question which apparently has a universality among optometrists. It is usually worded, "Thanks for the information you have given us—but *how* do we get into industry?" It is easy to become exasperated with such a query, especially after much preparation of data on industrial topics has preceded the lecture. Yet, there is no doubt of the sincerity or timeliness of such a perplexing question, and it behooves us to pause and *find* an answer to it.

The answer which has occurred to the author was prepared in a mimeographed pamphlet, "Basic Information in Occupational Vision." This has been distributed to optometrists before whom he has lectured during the past year. The many letters of appreciation and requests for additional copies has led to this presentation in printed form.

APPROACH TO THE PROBLEM

What is attempted here is a practical communication program between optometrists and industrial management; between management and the employee; and, between the optometrist and his patient. In any instance where the optometrist would wish to mimeograph or alter any of these suggested forms, he is free to do so. They are not copyrighted.

Optometry has been beset by sub-specialization advocates on occasions. This has led to debate and controversy. There are those who believe that it is a profession in which *all* optometrists should

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know the major aspects of the various fields that it covers. Certainly, "occupational optometry" is essentially *optometry*. While it leans on other disciplines for additional information, the average optometrist is perfectly capable of handling every industrial patient—providing he knows the vision requirements of the job.

ANALYZING VISUAL TASKS

[Form 1]
This check list will provide a rough analysis of the nature of visual tasks.
Check or Describe:

1. *Job Description.* Use standard job description code number where available _____. If unobtainable, give title, machine operated or material worked with _____.
2. *Work Distances.* Near _____.
   Intermediate _____
   Far _____
3. *Central Working Area.*
   a. Size: _____ ft. _____ in.
      Comment: _____
   b. Depth: Gross _____ Fine _____ Flat _____.
   c. Motion: Rapid _____ Slow _____ Rotating _____.
      Vertical _____ Horizontal _____ Other _____.
      Constant _____ Intermittent _____ Fixed _____.
   d. Illumination at Work Point: _____ ft. candles or ft. lamberts.
      If not measured: Bright _____ Dim _____ Glares _____.
      Comment: _____
4. *Detail for Discrimination.* Fine _____ Gross _____.
   Comment: _____
5. *Visual Attention Required.*
   Continuous _____ Intermittent _____ Casual _____.
   Comment: _____
6. *Colors to be Perceived and Discriminated.*
   a. All colors and shades _____.
   b. Blue and yellow _____.
   c. None _____.
7. *Peripheral Field.*
   a. Area of operation: Large _____ Small _____.
      Comment: _____
   b. Illumination: Bright _____ Good _____ Dim _____.
   c. Illumination Contrast to Central Working Area:
      High _____ Negatives _____ Low _____.
      Comment: _____.
8. *Hazards.*
   a. Chemical _____.
   b. Radiation _____.
   c. Physical _____
   d. Protective Eyewear Recommended _____
9. *Unusual Visual Demands.*
   _____
   _____
10. *Comments.*
    _____
    _____
    _____

(Modified by Richard Feinberg, Ph.D., D.O.S., President, Northern Illinois College of Optometry from form in Sight Saving Review, p. 130, Fall, 1948, Volume 18, No. 3.)

In the course of obtaining this information, he also creates a tool of communication between the management personnel, medical, safety and engineering departments and himself. It is simple in the extreme to make an appointment with any industrial organization to review the jobs and tasks at which one's patients are employed. A telephone call to the personnel director, medical director, nurse, or safety director in most instances, will lead to an invitation to visit the plant. Such a visit can be sterile or productive depending on the techniques employed. Since the stated purpose of such a visit is to ascertain the visual demands being made upon one's patient, a form has been prepared for the ready recording of such information. Form 1.

This form is easily interpretable and covers both quantitative and qualitative determinations. One form should be used for each job analyzed. Where a group of optometrists can pool their information, each member will benefit accordingly. Thus, it becomes a simple matter to accumulate a reference library of jobs in any industrial community. This should be of great value to the practitioner. Frequently, when management representatives see the manner in which this form is prepared and completed they, too, desire copies for their own use. Cooperation in preparing the forms is easily secured.

When one's patient recognizes the extent to which his practitioner has gone in obtaining this information, the value of the optometric services becomes enhanced greatly. This, then, in itself becomes one answer to those who have abused this honorable profession by what has been termed "quickie" examinations. No optometrist who would analyze a visual test as indicated by this check list would lend himself to the other undesirable commercial practices. Understanding this, management representatives will readily cooperate with this caliber of practitioner.

While the foregoing information sets up a communication medium between management and the optometrist, it is necessary to carry this concept still farther. In Form 2 which follows is a letter from the company to the doctor. It should be stressed that information obtained from one's patient regarding his vision demands on the job are often misleading. It is essential for the optometrist to have objective knowledge of the job requirements. The following letter and accompanying information are a first step in mutual understanding of the goals desired.

Likewise, the company must have the cooperation of its employees for ultimate success of this program. It may be stated parenthetically that no program can succeed by simply thrusting it upon employees.

THE X - Y COMPANY

[Form 2]

Dear Doctor:

_____, an employee of this Company, was recently tested on the_____. This instrument measures_____visual skills which have been found to have a direct bearing on job performance.

In view of the fact that this employee has failed to meet our minimum visual requirements, we have suggested that benefit might be obtained from professional advice. His visual test record is enclosed.

We should appreciate it if you would fill in the blanks below and return this letter to the patient. It is understood that the subject of fees is a matter of arrangement between you and your patient.

Very truly yours,

_____

Prescription: Yes_____ No_____ Visual Training: Yes_____ No_____.
Remarks:

_____

Doctor's signature

_____

address

_____

telephone

Those which have been most notable have first conveyed the purposes to the foreman and employees by means of conferences, bulletins, house organs and letters. The following are three sample letters which convey the results of a pre-clinical screening or classification test to the employee.

The first of these Form 3 is directed to an employee whose visual performance is adequate for the job demands; Form 4, is directed to an employee whose pre-clinical vision test indicates some visual deficiency in regard to job requirements; and Form 5, is a diplomatic letter recommending professional care within two years, or if symptoms manifest themselves which might indicate such a need.

THE X - Y COMPANY

[Form 3]

Dear Mr._____:

According to the analysis of our Occupational Vision Test which you recently took, it has been determined that your visual performance is adequate for the job you are now doing.

The fact that you have passed this vision test does not necessarily mean that your visual efficiency is perfect. It is possible for individuals to see well and still have symptoms of eye strain or fatigue. If you experience such symptoms now or in the future, it would be worth while for you to get a regular eye examination by a competent optometrist or ophthalmologist.

If you are wearing glasses, I recommend that they be used as directed by your doctor. Keep them clean and have them adjusted regularly. It is generally desirable to have your eyes re-examined at least every two years to make sure that your glasses continue to give you satisfactory service.

Very truly yours,

THE X - Y COMPANY

[Form 4]

Dear Mr. .....:

The Occupational Vision Test which you recently took, indicates that you might benefit by a visual examination. Accordingly, we suggest that you consult your optometrist or ophthalmologist in the near future.

Attached is a letter to your doctor and a record of your visual performance test, which is marked to show your visual impairment with regard to your job requirement. You may present the letter and card to your doctor, which explains our reason for suggesting that you see him.

Very truly yours,

THE X - Y COMPANY

[Form 5]

Dear Mr. .....:

The Occupational Vision Test, which you recently took, indicates that in some respects your vision might be improved. However, since you told us that you have had a clinical visual examination quite recently, it is not suggested that you visit your optometrist or ophthalmologist again at this time. Nevertheless, it is recommended that you have visual re-examination within at least two years of your last examination, or sooner if you have any undue fatigue or other suggestive symptoms associated with vision.

Very truly yours,

When the optometrist records his patient's case history and pre-clinical test information, he may then refer to his analysis of the visual task (see Form 1). These data will be invaluable to him in understanding the visual demands made upon his patient. When he has concluded his visual analysis, it is encumbent upon him then to relay to management, with the patient's permission, the results and recommendations at which he has arrived. Form 6 is designed for this purpose.

It may be seen from the form presented that no lengthy or technical discussion is necessary. In fact, such a presentation to management is contraindicated unless the optometrist is communicating with a physician who understands the language used. The information relayed back to management should be succinct and brief. The recommendations in the form suggested need only to be checked.

Finally, to complete the entire system of communications, it is suggested that in any unusual anomaly, pathology, or condition which may be due to normal development but requires special care, advice to the patient should be transmitted not only verbally by the doctor but also through a written communication. This offsets misunderstandings and fears where technical terms have been used. It creates renewed confidence in the doctor. Generally, such a message will be shown by the patient to friends and relatives.

REPORT FROM DOCTOR TO COMPANY WHICH HAS REFERRED EMPLOYEE FOR PROFESSIONAL SERVICES

[Form 6]

(Customary Letterhead)

Date.....

To: ..... Title.....

Company .....

Address .....

.....

Dear.....:

Thank you for referring.....(Employee's Name) .....(Dept. No. or Name) .....(Badge or Clock No.). This is a brief summary of my findings.

.....(Patient's Name) visited my office on.....(Date) at which time.....(He, She) was provided a thorough visual analysis. My conclusions are summarized in the following table:

		Meets Standard Without Glasses	Meets Standard With Old Glasses	Meets Standard With New Glasses	Improved By New Glasses, But Not to Extent of Standard	Vision Training Advised	Uncorrectible	See Note
Near	Acuity							
	Right							
	Left							
	Both							
Far	Acuity							
	Right							
	Left							
	Both							
Near	Phoria							
Far	Phoria							
Depth								
Color					XXX	XX	XX	
Other								

Recommendations:

( ) No need for glasses to be worn on job. (This refers to corrective glasses only and has no bearing on safety glasses requirements)

( ) Corrective glasses should be worn on job.

( ) Old glasses satisfactory.

( ) New glasses prescribed.

( ) Safety glasses should be worn on the job because of employee's impaired vision.

( ) Referred to .....

.....

( ) (Other) .....

.....

If further information is desired, or if I may be of any further service, please do not hesitate to call me.

Yours very truly,

.....

(Doctor's Signature)

.....

(Address)

.....

(Telephone)

Forms 7 and 8 which follow relate to conditions of monocular vision and presbyopia respectively. Similar letters may be designed for the various anomalies and pathologies encountered in practice.

[Form 7]

(CUSTOMARY LETTERHEAD)

To: ..... Date.....

MONOCULAR VISION

An examination of your eyes shows that you are seeing mainly, or entirely, with one eye. This is called Monocular vision.

You unquestionably realize that if vision in your better eye were impaired you would be seriously handicapped.

You can protect that good eye in several ways:

1. Wear your safety glasses everywhere in the factory.
2. Know the plant safety rules and follow them.
3. Keep your work place clear and in order.
4. See your eye specialist regularly and follow his advice. Vision is your most prized possession.

Signed

(CUSTOMARY LETTERHEAD)

[Form 8]

To: ..... Date.....

PRESBYOPIA

When a man or woman reaches the age of 38 or 40 (sometimes a little earlier or later) certain changes begin to take place in his or her eyes.

The first evidence of these changes is the difficulty of reading print or seeing fine detail as well as one used to when younger. This makes it necessary to hold the printed page farther and farther away to see clearly.

This is a natural development in almost everyone. It is called Presbyopia and is explained simply as a condition in which the eye no longer distinguishes near objects.

There is no need to fear presbyopia. One only needs to wear suitable glasses which will make near objects clearer again. Your doctor knows how to prescribe for this.

The glasses provided to you may be either designed to correct solely for the near point or they may be bifocals. Bifocals are lenses which enable one to see clearly at both distance and near. If these are prescribed for you, wear them faithfully. In many instances the first few weeks of wearing bifocals may be a little difficult, but eventually you will be most happy with them.

Do not hesitate to discuss your problems and questions relating to presbyopia with your doctor.

Signed

This, then, is a system recommended to the practitioner which, if adopted, will secure for him entrance into industry and continuous correspondence and referral from it.

The optometrist will find his interest in this work-world a rewarding one. He will find great satisfaction in rendering highly important services to the employee-patient and to American industry.

EDUCATION FOR SURVIVAL*

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There are times when it is advantageous to survey the road one has traveled. When this is done objectively and tempered with common sense, some important clues as to how best to proceed in the future may be gained. This procedure is as useful for a profession as it is for an individual.

It is possible to undertake such an examination from different points of view. In the case of a profession, one could examine the past record for progress in the development of favorable legislation, support of ethical and moral principles, scientific and technologic discoveries, expansion of professional groups and societies, enhancement of inter-professional status and so on. All of these areas may be explored with considerable satisfaction in the optometric profession. Such a notable record of achievement must be attributed to the development of the individual members who constitute the profession.

From a more restricted standpoint one could examine the development of the individual practitioner and thereby gain some insight into the overall pattern of progress. In particular, I am referring to his academic and clinical development—to the facilities and means available at the undergraduate and, to some extent, graduate level of education.

That any profession can only gain as much acceptance as its average member is, I believe, an acceptable truism. It is possible for an individual to reach certain limits of better or less than average ability but the boundaries are fairly well delineated by the status of the profession as a whole. Outside these limits it does not much matter how good a refractionist one is or how well his office may be furnished. As a member of a group or profession one will soon find himself fairly well classified, and his personal status and prestige is dependent upon that of the group.

The more individualistic practitioner will probably find this a frustrating situation. He will not relish being identified with a group—whether that group is above or below the level of his own ability.

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To some extent we are all individualists. We would each like to feel that the services we render are superior or even that they cannot be duplicated by someone else. In a fairly restricted area of service this may be true. In the broader areas of professional and community status and recognition it is probably not.

The psychologists call this phenomenon stereotyping and while it may be deplorable, shocking and intolerant it is a common occurrence nevertheless. Even the most liberal minded individual engages in it at one time or another. It usually begins with "All so and so's are, do, act, become, etc." I don't wish to imply that there are no exceptions to this. When these do occur however, they are just that—exceptions. Therefore, depending on the status of the profession, the member may take pride in belonging to it or he may feel uncomfortable at the identification—but identification there will be in any event.

If we accept this situation realistically, the consequences are quite clear. Those who take pride in being an optometrist will wish to further enhance the profession's position: those who do not will wish to raise it to where they feel they could take pride. How can this be done?

One important way in which the prestige of a profession is advanced is through continued progress in the academic training which the undergraduate receives. The optometric educational program should be (if it is not already) of vital concern to every practitioner. It is as much his responsibility as it is that of the educator or state board member. His interest, advice, encouragement and support help to shape and develop it. The necessity for this becomes obvious when one remembers that as the undergraduate takes his place in the profession, he will contribute or detract from its status and thereby affect every member in it. If the academic and clinical training is good, the new graduate will probably be an asset to his profession. If his training (and correlated enthusiasm) is poor, he will not only add nothing but will almost surely soon become a liability.

During the past ten years our educational institutions have made tremendous progress. In doing so they have advanced the prestige of the profession immeasurably and, for the most part, they have done it on their own. Currently, and despite the increase in tuition fees, they are still doing it. Those who have been privileged to get a professional or academic education, will surely realize that the greater part of the cost of their training was borne by their alma maters. Unfortunately, this state of affairs cannot go on indefinitely.

Let no one misunderstand my motives. I am not asking for

philanthropy. The professional man who supports his educational institutions through advice, interest or money or who encourages worthwhile young people to enter the field is only promoting his own welfare. He is helping no one but himself.

Many of the problems which are faced by optometric educational institutions are similar to the problems of other colleges throughout the country. The decrease in student enrollment and the loss in tuition is making it difficult to maintain existing facilities. There are some problems, however, which are peculiar to optometry schools and it is to these that I particularly wish to call attention.

In the optometric curriculum almost every member of the faculty must be a highly trained specialist in his particular field. Such men are not always readily available, particularly when industry and private practice offer greater financial inducements. This, for example, is the situation for medical specialists (e.g., anatomists, physiologists, pathologists, bacteriologists, ophthalmologists), physicists, illuminating engineers, psychologists and others.

The procurement of such trained personnel, outside the optometric courses proper, becomes a most important consideration in the designing of curricula. The inclusion of a given course may be determined by the particular specialties of one or more members of the teaching staff. Conversely, some courses cannot be offered until the personnel becomes available.

In the optometric specialties, the problem is even more severe. The number of optometrists with graduate degrees, particularly at the doctorate level, is small.

This state of affairs calls for definite remedial steps. Each of these requires the cooperation of the profession at large.

1. Expansion of facilities for graduate training of optometrists interested in a teaching career. The outstanding record established by Ohio State, California and Columbia Universities should be broadened and similar programs should be instituted at other optometric schools.

2. Financial support through grants-in-aid or scholarships to qualified optometric graduates who wish to continue their education at the graduate level in other Universities. This would call for the expansion of a program similar to the one now in effect through the American Optometric Foundation. The contribution of such men to the prestige of the profession would far outweigh the financial investments involved.

3. Private or organizational endowments, awards, bequests and gifts to optometric colleges will make it possible for these institutions

to expand their physical and technical facilities and thus attract qualified personnel interested not only in teaching but in continuing their individual research. The scientific progress of the profession in the past has been due, in no small measure, to the individual research carried out by members of the faculty of our educational institutions.

4. Serious exploration of the possibilities of subsidizing the colleges of optometry (or specialized institutes of such colleges such as optics, illumination, industrial vision, remedial reading, aniseikonia, strabismus, etc.). Such financial support could be based on some reasonable criterion of capacity and/or achievement. This could be arranged through an agency of the national or state optometric associations. Once such a program is seriously started, and the trained personnel available, the support of industry and of government can be solicited.

5. Encouragement of outstanding qualified private practitioners to donate part of their time for the teaching of clinical subjects and particularly to assist in the training of the optometric interne in the clinic. Such clinical professorships have long been used with notable success in medicine and dentistry. These affiliations should carry the necessary prestige to attract such men.

What has been said above concerning the availability of adequate personnel may be repeated for the equipment needed in optometric education. At the undergraduate level and even more at the graduate level, the instruments and apparatus are often so specialized that they must be individually constructed. This, for example, is the case in physical and geometric optics, visual psychology, aniseikonia, strabismus and physiologic optics. As a result it is necessary to obtain and maintain drafting, designing and workshop facilities. While there have no doubt been geniuses who made important discoveries with limited equipment this is no longer generally possible. The technologic advances of our age usually require highly technical equipment without which, no matter how inspired the scientist may be, little can be accomplished.

In this respect the practitioner can help by contributing apparatus and equipment which can be rebuilt or redesigned. Also needed are the instruments and tools necessary for the construction of such equipment. No doubt many optometrists have hobby workshops in which they might help to build apparatus.

The optometric curriculum consists of courses for which adequate textbook material is often not available. Although there has been considerable progress in the publication of texts on refraction, orthoptics, contact lenses, physiologic optics, etc., these have been, for the most

part, written by men outside the profession. While this in no way detracts from their value, it does mean that the point of view and emphasis is not optometric. Only in the last few years have books on physiologic optics appeared which, at least in their completeness, justify their use in the expanded time devoted to this subject in our schools today.

Positive steps need be taken in writing and encouraging optometric educators to write much needed text books. Faculty salaries do not usually permit the assumption of the cost of publication of a book or monograph. Such support could be extended through national and state associations or certain organizations may commission a particular educator to write a specific text. It is important to remember that, because one book is already available on a subject, this does not exhaust the field. Different approaches and points of view provide the necessary atmosphere for progress. One has only to point to the large number of texts on anatomy, a subject in which there is presumably little difference of opinion, to emphasize this point.

These then are some of the problems faced by our educational institutions today. I have pointed out some of the steps which can be taken by the profession and particularly by the individual practitioner to help remedy the situation. These steps are so varied and diverse that there is at least one way available to each and every member of the profession. If he cannot contribute financial support he can give of his time, skill, advice or encouragement.

A common cliche has it that a chain can be only as strong as its weakest link. Let us not allow optometric education to become that critical link. By providing the needed support optometrists will advance their profession and, inevitably, their own prestige. It is no longer a question of choice but a matter of survival.

THE PULLMAN STUDY. — A VISUAL SURVEY OF PULLMAN SCHOOL CHILDREN*

Part II

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A second analysis of interest is whether there are any systematic or chance variations between different age groups on the same variable. One can observe that the mean visual acuity denominator increases with age. Some of the other tests such as vertical phoria at near and far show very little change from one age to another. It is impossible to draw any conclusions by inspection of the differences between the mean scores at different ages without taking into account the variability within the age groups. We can use the analysis of variance technique and apply the "F" test to answer the above questions, provided the variances within the age groups are relatively homogeneous. By applying the Bartlett test for homogeneity of variance,[9] we find that the variances for different age groups on the same test are sufficiently similar except those of the visual acuities. All of the visual acuities show great heterogeneity and none of these scores were submitted to the "F" test; all the other visual tests were analyzed in this manner.

Our analysis indicates that of the 22 tests, eight show no significant differences from one age to another, three show significant differences between age levels at the .01 level of confidence and the remaining eleven show highly significant differences between various ages. These results are presented in Table V.

In line with our earlier discussion concerning the comparing of results by different authors, we used the static retinoscopic findings as the measure of refractive state. This enables us to compare our results with those of Kempf, Collins and Jarman[17] and Hirsch,[14] since

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TABLE V

Results of an analysis of variance and "F" test with respect to age differences on all the visual tests except the visual acuity tests.

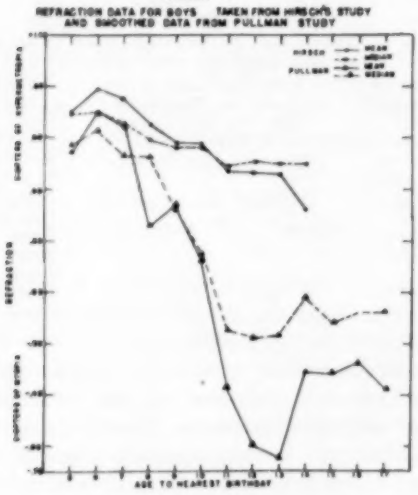
Tests Not Showing Significant Differences	Tests Significant at .01 Level of Confidence	Tests Exceeding the .001 Level
Dynamic Retinoscopy OD	Blur Base Out—near	Static Retinoscopy OD
Dynamic Retinoscopy OS	Break Base In—near	Static Retinoscopy OS
Recovery Base Out—far	Recovery Base In—near	Red-Green test OD
Recovery Base Out—near		Red-Green test OS
Lateral Phoria—near		Lateral Phoria—far
Vertical Phoria—far		Blur Base Out—far
Vertical Phoria—near		Break Base Out—far
Recovery Base In—far		Break Base In—far
		Break Base Out—near
		Near Pt. Convergence
		Interpupillary distance

both of these used equivalent spheres for summarizing the right eye static findings. Even here, however, we are confronted with certain differences in methodological techniques of varying degrees of importance. The Kempf, Collins and Jarman study used homatropine cycloplegia while Hirsch used a plus 1.50 diopter fogging lens and a motion picture cartoon as a target. Hirsch feels that this technique yields a refraction which is essentially the same as that obtained under a cycloplegic, though not all cycloplegics yield the same refraction, see Bothman.[5] In our study we used a plus-two diopter fogging and working lens with an illiterate E target projected on the screen. We feel that we should get more relaxation under these conditions than we would with a motion picture because of the strong attention value of the picture. For the purpose of making comparisons we are accepting the two assumptions that fogging yields results that are similar to cyloplegics[3] and that our method of fogging yields results that are similar to those obtained by Hirsch.[12]

In Table IV no attempt was made to separately present the static retinoscopic findings for boys and girls, since a Chi-Square test indicated that there was not a significant difference between the two groups. The same test applied to the data presented by Hirsch and by Kempf, Collins and Jarman indicated a very significant difference between boys and girls in their studies. Since both of these studies handle the data separately, we will do the same. In making these comparisons we propose to compare our results with those of Hirsch and then these two with those of Kempf.

Hirsch presents data covering the age range from five to fourteen while our range is five to seventeen. For comparison purposes we have omitted the fifteen through seventeen-year-olds. A comparison of the

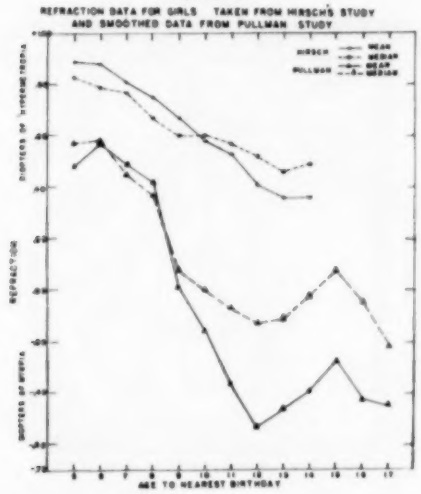
FIGURE 1.



means and medians for each age group from five to fourteen of Hirsch's data and the Pullman study are presented in Figure 1 for boys and Figures 2 for girls. Hirsch's values were taken from his Figures 1 and 2;[14] the Pullman values were smoothed by averaging three adjacent values, this process being required by the small number of cases. The number of cases in each age group are given in Table III.

The Kempf, Collins and Jarman study presents data for 937 boys and 892 girls six to twelve and "over" grouped in three three-year spans. These data are presented in quarters of a diopter. Hirsch presents a table which groups the children from five to fourteen in two-year spans and gives the proportion of cases in each one diopter unit. Consequently, in order to adjust the data of these three studies it is necessary to regroup Hirsch's data and the Pullman data into three-year spans to equal the Kempf, Collins and Jarman USPHS data. Since Hirsch's first class was composed of the five and six year olds and the second of the seven and eight year olds, whereas the Kempf et al study's first class is composed of age groups six to eight years, it was necessary to separate the five and six year groups and add the sixes to the seven and eights. This process had to be repeated with several other age groups of Hirsch's data. This was accomplished by applying the proportions given for the five-and-six groups together to the six-year group alone, and combining the resulting frequencies with the frequencies obtained for

FIGURE 2.



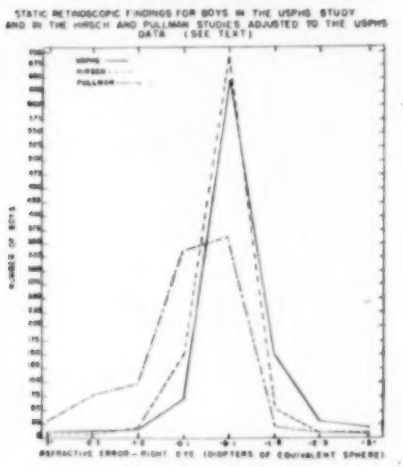
the seven and eight year olds.

This process should not materially bias the data since the proportions themselves take into account both sets of data. For the Pullman data the values were simply tabulated by three-year groups.

The second adjustment that had to be made was to adjust the Kempf, Collins and Jarman and the Pullman data to that given by Hirsch, since his data was presented in the grossest intervals. This was done by accumulating cases into one-diopter intervals. Finally, the number of cases in each age level were equated to those given in the Kempf, Collins and Jarman study, using the proportions found in each diopter class in the other studies. This was necessary to eliminate the influence of age.

The curves based on the adjusted data of the three studies are presented in Figures 3 and 4 for boys and girls, respectively. While the curves for the Hirsch and the Kempf et al studies are similar, that for the Pullman study is quite different. As indicated earlier it is possible to draw comparisons between frequency distributions in terms of the skewness of the distributions. This measure can not be applied to the adjusted curves presented in Figures 3 and 4, because the necessary data are not available. However, Hirsch presents a table, Table I,[14] which enables us to obtain a satisfactory estimate of the skewness of each of his combined age groups. This was done using the following formula:

FIGURE 3


STATIC RETINOSCOPIC FINDINGS FOR BOYS IN THE USPHS STUDY AND IN THE HIRSCH AND PULLMAN STUDIES ADJUSTED TO THE USPHS DATA (SEE TEXT)
USPHS
HIRSCH
PULLMAN
NUMBER OF BOYS
REFRACTIVE ERROR—RIGHT EYE (DIOPTERS OF EQUIVALENT SPHERE)

$$\text{Skewness} = \frac{Q_1 + Q_3 - 2\ \text{Mdn.}}{2\ Q}$$

This formula yields values which vary between +1.0 and —1.0, with zero representing no skewness. The measures of skewness and the corresponding medians for the two studies are presented in Table VI.

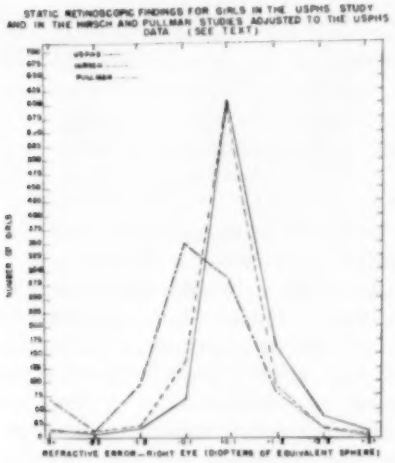
TABLE VI

Measures of skewness and corresponding medians in diopters for boys and girls in the same age groups of the Hirsch study and the Pullman study.

	BOYS				GIRLS			
Age	Hirsch Study		Pullman Study		Hirsch Study		Pullman Study	
Groups	Skewness	Median	Skewness	Median	Skewness	Median	Skewness	Median
5- 6	.000	.60	.021	.53	—.018	.68	.025	.46
7- 8	.037	.50	.011	.44	.024	.59	.040	.65
9-10	.000	.41	.000	.30	.009	.48	.016	.00
11-12	.009	.35	—.200	—.10	.085	.34	—.200	—.05
13-14	—.025	.34	—.500	.00	—.016	.33	.000	—.20

A third comparison that might be made between these three studies is that between the medians for the boys and for the girls and the standard errors of these medians. The data for this comparison is presented in Table VII. The medians were computed from the original data given in the studies. The median for Hirsch's data is the median of the medians based on those given in his study. Since it is not possible to average a set of medians, and, since he does not present the necessary data for computing a median for either sex, the only procedure available is

FIGURE 4.


STATIC RETINOSCOPIC FINDINGS FOR GIRLS IN THE USPHS STUDY AND IN THE HIRSCH AND PULLMAN STUDIES ADJUSTED TO THE USPHS DATA (SEE TEXT)
USPHS
HIRSCH
PULLMAN
NUMBER OF GIRLS
REFRACTIVE ERROR—RIGHT EYE (DIOPTERS OF EQUIVALENT SPHERE)

to take a median of the medians and use this as an estimate of the median of the total data for either sex. This has been done and it is this value which is given in Table VII.

TABLE VII

Medians and probable errors of the medians in diopters, based on the original data for boys and girls given in the studies of Kempf, Collins and Jarman (USPHS), Hirsch and the Pullman study.

	Kempf, Collins & Jarman		Hirsch		Pullman	
	Median	Probable Error	Median	Probable Error	Median	Probable Error
Boys	+.64	.0145	+.41	.0052	+.19	.0295
Girls	+.67	.0151	+.48	.0051	+.13	.0367

As a final comparison between our data and those of Hirsch, we determined for each age group the percentage of boys and girls who had more than one diopter of myopia. These percentages are presented in Table VIII together with the values taken from Hirsch's Table IV.[14]

DISCUSSION

As Tables I and II clearly indicate the sample upon which this study is based is heavily biased by the inclusion of a large number of children of parents who are classified as professional and, in this case, primarily college instructors and personnel. While this bias limits the generalizations which can be made from this sample, it also permits us to examine the characteristics of a group of children who should

TABLE VIII

Percentage of children with myopia in excess of 1.00 D. from Hirsch's data and the Pullman data.

	Hirsch			Pullman		
Age	Girls	Boys	Ratio	Girls	Boys	Ratio
5- 6	0.45	0.67	67	4.17	0.00	—
7- 8	0.98	0.90	109	2.60	5.62	46
9-10	2.01	1.82	110	19.44	9.68	201
11-12	5.77	3.08	187	20.00	27.27	73
13-14	5.78	5.08	114	25.71	28.57	90

fall at the extreme of a great amount of close work on a continuum of close work from small to large amounts. Further, since this group shows a particularly high percentage of myopia, thirty per cent have a negative refractive error, we have available a large number of myopes for the purpose of characterization and comparison with non-myopes. This sample of students also includes a sizable number of children, 160, who should represent the small-amount of close work end of our continuum. Thus our purpose in this and later papers is to contrast these two extremes with each other and with samples based on more normal populations such as those of Hirsch[14] and Kempf et al USPHS study.[17]

The results presented in Table III are of special interest with respect to variations between our two extremes and between ages. If we were to find that the children of professional parents are greatly different on any measure than the children of non-professional parents, we would expect bimodal distributions with considerable difference between the means and medians and with large standard deviations and quartile deviations. These differences would be particularly pronounced because we are comparing the two extremes of a distribution without a large proportion of middle cases which might be expected to overlap both ends. This procedure of comparing extremes tends to maximize differences. The measures in Table IV with the possible exception of the visual acuity measures, do not show the characteristics mentioned above which would support the concept of large differences between our extreme groups. In a later paper a comparison will be made between the two extreme groups and definite conclusions with respect to the occurrence and nature of the differences presented.

The measures of far visual acuity and the measures of refractive error indicate a major change taking place at ten years of age. The mean and measures of variation of these tests show a considerable stability in the age groups from five through nine years, with small S.D.'s and Q's. The ten-year-olds show a relatively large drop in visual acuity

and a negative mean refractive error on the red-green and static retinoscopy. These changes are maintained in varying degrees in all the higher age groups, since the mean refractive error remains negative and the S.D.'s and Q's continue to show an increase in variability. This relationship is strikingly demonstrated in Figures 1 and 2 where the means and medians of the age groups are compared with the means and medians taken from Hirsch's data. Interestingly enough both the boys and the girls show a slight increase in mean and median refractive error from five to six and a drop after six. Hirsch found this occurring only with the boys but this relationship has also been found by Brown[7] and by Slataper.[26] The relationship between the mean and median scores at different ages for both boys and girls show the same relative relation as that found by Hirsch with the mean being more toward the plus at the younger ages and more minus at the older ages than the median. Therefore the two curves must cross. The age of crossing is different in the Pullman data than in the Hirsch data. The curves for the girls intersect a little before the age of ten and a little after ten for the boys in Hirsch's study, whereas the corresponding figures for the Pullman study are a little before nine and just at ten respectively. The same shifting toward the younger ages in the Pullman study with respect to the Hirsch study is noted in every comparison drawn between the two.

Aside from the measures of visual acuity and refractive error, Tables IV and V indicate that certain visual tests are not influenced by the age variable. The vertical phoria tests at far and near and the near point tests of phoria, and ductions, particularly, seem to be independent of age, since an analysis of variance does not indicate any highly significant differences (greater than .01 level of confidence), on these measures from one age group to another. The lack of difference on the near tests may be related to the near visual acuity which seems to be only slightly influenced by age variation. A lack of difference between age levels suggests further that there may be no difference on these tests between myopes and non-myopes, and that such tests are of little value in distinguishing between these two groups. This hypothesis has yet to be tested with the present data.

On the other hand such measures as the static retinoscopic findings, the red-green test, and most of the far tests show a very significant difference between the various age groups. These will be analyzed on a myopic versus non-myopic dichtomy at a later time.

Figures 3 and 4 based on the data taken from the Kempf, Collins and Jarman study,[17] the Hirsch study[14] and the Pullman study and adjusted so as to remove the influence of age and different numbers of

children tested, reveal close agreement between the first two studies but with some characteristic differences. The Pullman data shows a curve with much less kurtosis but much more skewness toward the minus side. The Kempf study which was made in 1924 using homatropine cycloplegic shows a consistently higher proportion of hypermetropes among both boys and girls and a consistently lower proportion of myopes among both sexes than that found by Hirsch in his study made in 1950 and 1951. There are two historical explanations which might be advanced to explain this difference. First, since the Kempf study used cycloplegic and Hirsch did not, a higher proportion of hypermetropes is to be expected, and was found in the Kempf study. The second explanation would run about as follows: the amount of near work and the amount of reading which is required of children has increased in the quarter of a century between the two studies. This increased near work has been accompanied by an increase in the incidence of myopia which is demonstrated by the later study. At the present time neither of these alternatives can be ruled out.

The curves based on the Pullman data are entirely unlike the others, indicating that our sample is likewise different. The differences are so great that they can not be explained on the basis of any methodological differences, and warrant the conclusion that children of college instructors (primarily) show decidedly more myopia than children drawn from the general population. Because of the grossness of the intervals used by Hirsch these curves are only approximations and the values for the medians given in Table VII must be considered. These values support the conclusions to be drawn from the curves: namely, that the Kempf study shows medians which are about two-thirds of a diopter hypermetropic, the Hirsch study medians which are about .45 diopter plus and the Pullman study about .15 diopter plus. The probable errors of these medians indicate that all these values are stable within any meaningful limits.

As mentioned earlier the Pullman data is more skewed than either the Hirsch or the Kempf data indicating that there is an exceptionally high proportion of myopes in the Pullman sample. Tests of skewness applied to the individual age groups of the Hirsch and Pullman studies bear this out (Table VI). In general at the higher age levels the Pullman data is more skewed to the minus side while at the lower age levels, below ten, the curves show about the same degree of skewness as in the Hirsch study.

When we compare the percentage of myopes of more than one diopter among both boys and girls in the Pullman and Hirsch studies,

we find considerable disagreement on several counts. From Table VIII it is apparent that the percentage of myopia among boys is higher in the Pullman study whereas the percentage is higher among girls in the Hirsch study. Again, the age at which the largest increase in percentage of myopia occurs is different in the two studies. Hirsch refers to the large difference between the girls and the boys at the 11 to 12 age range whereas this large difference takes place at the 9 to 10 age range in the Pullman study. If we draw the same conclusion as Hirsch draws, namely, that this difference is probably related to the earlier maturation of girls with respect to boys, we would have to conclude that the girls in the Pullman study mature around ten years of age and the boys around eleven or twelve. Accepting Martin's[20] figures as given by Hirsch, the girls in the Pullman study would be reaching the menarche in considerable numbers at the age of ten, which is the lower limit given by Martin. The same situation would hold for boys since the increase occurs at the 11 to 12 age range while Martin gives twelve as the lower limit. More nearly comparable sets of data are those given by Simmons and Greulich and by Shuttleworth. The Simmons and Greulich[25] data of 200 girls who were enrolled in the Brush Foundation Study of Growth and Development gave a mean age at menarche of 12.5 years. These girls generally came from families of high socio-economic status in Cleveland, Ohio. Shuttleworth[24] (p. 206) gives the mean age at menarche of the early maturing girls in the Harvard Growth Studies as 11.8 years. The proportion of myopes over one diopter in the Pullman study was 14.29 per cent at nine years of age and 24.32 per cent at ten years of age. While Greulich[11] indicates that there is evidence that good nutrition and favorable environment tends to hasten the onset of puberty, it is highly doubtful whether the nine year old girls or even the ten year olds in the Pullman study have reached the menarche. Further, since none of the girls have myopia in excess of 6.0 diopters, it is also doubtful whether we are dealing with cases of pathological, congenital or degenerative myopia as has been suggested by several writers.[12, 28]

We are not prepared at this time to indicate the possible causes for the early onset of myopia or the high frequency encountered among the students in this study. We hope to be able to do so in the future.

SUMMARY

A visual survey utilizing most of the measures constituting a complete optometric examination was performed on 651 children in the college town of Pullman, Washington. More than half of the children in the survey had parents who were associated with the

college in an instructional or similar capacity. The results of this survey have been compared with surveys performed on large samples of children drawn from more general populations.

The following conclusions are supported by the results:

(1) The usual increase in the incidence of myopia with an increase in age was found. This increase differs from that found by Hirsch,[14] for example, in that the onset was earlier, about nine to ten in girls and eleven to twelve in boys. Also the percentage of cases showing a minus refractive error was about double that found by Hirsch (30 per cent as against 14.8 per cent for the total groups; 27.5 per cent for boys against 14.8 per cent, and 32.7 per cent for girls against 14.8 per cent.)

(2) In terms of skewness of age distribution curves a result similar to Hirsch's was found: the distribution of refraction is skewed toward the hyperopic side until the age of nine or ten, is symmetrical at this age, and then becomes increasingly skewed toward the myopic side with increased age.

(3) The higher hyperopes decrease in number with increasing age about as sharply as the number of myopes increases.

(4) Hyperopia increases from age five to six for both boys and girls and then decreases.

(5) There are more boys than girls with myopia greater than 1.0 in all age ranges between five and fourteen except in the nine to ten age range.

(6) Girls had a higher percentage of myopia than the boys.

(7) The following visual tests did not vary significantly with age in our sample: dynamic retinoscopy, recovery base-out at far and near, lateral phoria at near, vertical phoria at far and near, recovery base-in at far, break and recovery base-in at near and blur base-out at near. All the other tests showed a highly significant variation with age.

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IMPORTANT DECISIONS BEFORE A. O. A. SEATTLE CONGRESS

The coming American Optometric Association Congress at Seattle provides an important conference ground at which many of the important problems facing the profession should be discussed. The meeting must be far more than a personal get-together of delegates and member optometrists. That those attending the Congress will enjoy themselves goes without saying—and, of course, they should—but the meeting itself is of fundamental importance to the future of optometry—and the deliberations and decisions of the delegates will have a far reaching effect, not only on optometrists, but on the visual well being of millions of Americans.

What are some of the problems before the profession and thus the Congress? Among those which should be mentioned are:

● The economic question of optometric net income. This question is closely tied in with that of adequate professional fees and the ultimate abandonment of a fee scale based upon a mark-up on ophthalmic materials. Optometrists should be further encouraged by the A.O.A. to realize the true value of their services and to set their professional fees at such levels as to make the practice of optometry financially attractive.

● The need for centralized planning and direction to improve existing optometric laws. This is work requiring expert study, not usually available to local and State groups. Here the A.O.A. should assume the job of overall programming and direction.

● A study of all the questions effecting proper interprofessional relationships with medicine is in order. Particularly necessary is a consideration of essential consultant relationships between optometrists and ophthalmologists in the patient's interest.

● A study is also needed in the relationships between optometry and dispensing opticians. Here broad areas of policy must be collectively reviewed and decisions be made affecting the future conduct of both groups.

● Steps must be taken to speed the elimination of the "Quickie refractionist," whether he practices in a commercial optometric establishment, as a stooge for a cut-price optician, or in an assembly-line insurance or union "quickie" health program.

● Optometry's sound fundamental position must be explained and sold to the editors and publishers of America. As a health project this can be done. Conferences, leading to a change in the publishers' overall policy regarding advertising of visual health services, should be set in motion.

● Consideration should be given to starting a large scale national advertising public relations program to stimulate additional interest in better visual care. Such a program would materially increase the number of refractions done each year, and will result in better eye care for all citizens.

When these and other questions are solved, the student enrollment problem in our schools and colleges, to some extent, will rectify itself. Student procurement to a marked degree rests on the economic security of the present day practitioner and how he conducts his role in serving the public. As the practice of optometry is made more attractive to both the practitioner and the public, the number of college men and women seeking professional careers in optometry will increase. The

coming A.O.A. Congress at Seattle should play an important part in this educational matter through its deliberations on these important problems.

It is evident from the foregoing that the Seattle Congress is a *must* for all optometrists. Every practitioner who can arrange the trip should plan to be in Seattle—June 20, 21, 22 and 23 for this important policy making meeting. Not only will you enjoy yourself with hundreds of other optometric families who will be there, but you will help our A.O.A. in its planning for the future.

CAREL C. KOCH

SPECIAL REPORT

THE NON-INSURABILITY OF OCULAR REFRACTIONS*

Monroe J. Hirsch†
Ojai, California

Optometry is today faced with two major problems which are usually thought of as separate and distinct, but which are in reality closely related. The first of these is the problem of the "quickie" or "commercial" optometrist. This problem has long been with optometry. Very recently, with articles by Wahl, and by Kohn, the problem has again come to the front. The problem stems from the fact that in the rendering of optometric services, as in almost every other endeavor, there are inferior types of service and material which can be substituted for what we believe to be the "real thing." In an attempt to gain the patronage of a portion of the public, certain optometrists offer inferior services and materials at a price. It is stressed here that this is not a problem that is new, nor is it one that is peculiar to optometry. Whatever the product or service, it can be reduced in quality and sold for less. Unhappily in this case, one aspect of the public health is at stake.

The second major problem is that of the various health plans. Initially these plans stem from a desire on the part of the public for some set-up which would enable people to prepay a moderate sum of

*An abridgment of the material presented before the California Optometric Association, San Francisco, California, February 21, 1954. For publication in the April, 1954, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist, Ph.D., Fellow, American Academy of Optometry.

money regularly in order to remove the risk of exceptionally high medical bills in time of catastrophe. However, as the situation developed, it became clear that universal federal health insurance was not in prospect for the immediate future, and a number of substitute "voluntary" plans came into being. Refraction was included in some of these plans in an effort to make the service as complete as possible—an accomplishment which would help in selling the plan to the public. It should be clear, however, that another aspect of these plans is the fact that they are competitive in price. It should also be clear that periodic examination of the eyes or vision (refraction) is a service which can be used almost universally. Therefore, faced with the problem of keeping insurance prices down and yet offering a service of which almost all people would take advantage, the plans which include refraction have been offering not the refractive service which professional optometrists would approve, but rather the "quickie" type of service. As a result, it is seen, the two problems are really the same problem.

The situation facing the professional optometrist is this: Visual service may be of many degrees of completeness. While the public thinks of "eye examination" and "glasses" as specific things, they are actually many things to many men. The professional and ethical optometrist who wishes to offer the best that there is is forced to compete with regard to cost with those who are willing to cut corners insofar as time and materials are concerned. The public is all too often not aware of the differences in the thing that is being offered.

This, then, is the problem. Whether the inferior service is sold as an independent service in a commercial optometrist's "optical parlor," or as part of a prepaid health plan, makes little difference. Now, what of the solutions to this problem? The solution offered by Wahl and by Kohn in their recent articles is threefold: Optometrists must (a) further educate themselves through post-graduate education; (b) use first quality materials; (c) engage more vigorously in public relations plans. Clearly these are all good suggestions. In the fight between the "good services and materials" vs. "quickie services and inferior materials," it would be well if the forces of "good" were, in fact, offering the best services, i.e., by keeping abreast of new changes and incorporating these into their practices, offering the best materials, and letting the public know that such was the case. However, a moment's reflection should show that this is not a complete solution. Professional optometrists are today well trained for their work and probably spend more time and money on lectures and other forms of education than any other healing art group. Similarly, most professional optometrists already

use fine materials. The third point, that of public relations, will certainly help and will be discussed more fully in a later report. So long as post-graduate education is not limited to adherence to one philosophy or subscription to one set of papers or journal, and so long as "quality" materials are not defined as those of a single manufacturer, the suggestions are good. However, they will not completely solve the problem.

A second type of solution, and one of considerably less merit, is that also being proposed at the present time. This is the proposal to include refraction as a service in health policies issued by various private insurance companies. Since optometrists are particularly concerned, it seems proper to devote enough time to this proposal to consider it fully.

On many points concerning the various types of prepaid health plans there is little difference of opinion, and it is well to list these at the outset of any discussion. As these plans affect "non-pathologic" eye care, the following may be said to be points of almost universal agreement.

(1) There is little or no chance of an overall comprehensive, federal compulsory health insurance plan being adopted within the next few years.

(2) Policies on visual care issued by private companies (much like the present polio policies) are impractical, since visual care does not satisfy the basic requirements of insurable items:

(a) Need for visual care is not a rare occurrence, but is almost universal.

(b) The cost of visual care is not catastrophic.

For example, it may be stated that if a great many persons take out polio insurance then the one person, [or several], of the group who does get polio will be the beneficiary. In a sense, insurance is a bet between the policy holder and the company with the odds being set by the frequency of occurrence of the disease insured against. The rarer the occurrence of the disease, the higher the odds. When the odds fall too low, because the occurrence is too common, the item is considered uninsurable.

(c) The individual purchasing the insurance must not have previous knowledge that the item insured against will definitely occur. A person who knows he has a fatal disease cannot obtain life insurance. On the other hand, patients do know whether or not they are likely to require eye care.

It should be clear, then, that policies on visual care alone are not practical.

(3) The group insurance plans, and some of the union plans in

which care is provided by men who are essentially employees of the company are unsatisfactory. These plans, insofar as eye care is concerned, fall down because the service is being offered at a low price—and poor service must result. Many people are availing themselves of these services, and this forms a two-fold problem for private optometric practitioners. These are concerned because:

(a) The patients of these plans are not receiving the best eye care. They receive "quickie" eye examinations—and glasses at a price.

(b) The private practicing optometrist is losing these people as patients.

(4) As matters stand now, eye care is obtained in these ways:

(a) By consulting the private practicing optometrist or ophthalmologist and paying a fee.

(b) By receiving care from an optometrist specified by a group plan.

(c) By getting no care or inadequate care due to lack of funds.

(d) By receiving care through charitable institutions.

Groups a, c, and d have always been with us, while group b is a recent phenomenon—and one causing grave concern among practitioners.

Recently, some optometrists and their advisors have conceived the idea of including refraction in regular health policies issued by private companies. It is in the light of the foregoing assumptions that the advisability of such a procedure is now considered.

The first question we may examine is why optometrists wish to do this, i.e., why do they wish to have eye care included? Since three parties are concerned, clearly one or more should benefit. Thus, the plan may be (a) good for the visual welfare of the public, (b) good for the optometrists, and/or (c) good for the insurance companies. The third possibility may be dismissed immediately since we may safely assume that optometrists are not militantly engaged in defending the welfare of insurance groups. Let us then consider the other two.

(a) *The Public Will Benefit*

Including refraction in insurance policies will have no appreciable effect upon the people who are now members of group health plans (group 4-b above), so the problem is not being met insofar as they are concerned. Now, what about the others? The people who would buy health insurance and avail themselves of provisions for refraction are for the most part people who are already receiving optometric care as private patients (group 4-a). Surely they will receive no better care if the insurance company pays a part of the bill than they are now receiving. The need for refraction is so universal (point 2) that the

insurance premium would have to be almost as high as the benefit—and when we allow for sales and administrative costs, they would probably be as high or higher, so the public will not save money.

The segment of the population which now receives no care (group 4-c) because they have little or no money is not composed of insurance-buying people.

Thus, in summarizing the benefits to the public, we see that those who are at present covered under a group health plan will continue to get inadequate "quickie" eye care; those at present unable to pay for eye care will not benefit; and those who will buy the insurance will get the same care they now receive and at about the same price. Who benefits?

Incidentally, the situation is even worse than has been suggested, for actually the care under an insurance plan would probably deteriorate. The reason is that minimum fees tend to become maximum fees. And since no one gets anything he does not pay for, service will tend to become minimum also. To be concrete, suppose that a patient has a policy which entitles him to $10.00 every three years for a refraction. First of all, the patient will limit himself to a refraction every three years. In this way the insurance company has set the pattern for how often a refraction is necessary. But, the need for this differs from patient to patient, and the suggestion should remain the prerogative of the optometrist.

Furthermore, such an insured patient will tend to go to his optometrist and say "I want my eyes examined. The insurance company allows $10.00. Will this cover it?" The optometrist can do one of four things: (a) He can agree to do the job and give the man $10.00 worth, whether he needs more or not—in which case the quality of eye care has suffered. (b) He can say that it may be higher—in which case all too many patients will seek out an optometrist whose answer will fall into category (a), and, hence, not only will the quality of eye care suffer, but so will the honest optometrist. (c) He can agree to the $10.00 fee but give whatever service is needed, even if it should cost more—in which case we shall soon have a shortage of optometrists due to financial problems—and again, eye care suffers—or (d) he can ask for more than the $10.00 but only do a $10.00 examination—which is, of course, as dishonest as it is improbable.

Again, we see that in no way has the public benefited—and, in fact, it has suffered.

Let us examine the second possible advantage, that to the optometrist.

(b) *Optometrists Will Benefit*

The arguments are identical to those used above. Namely:

1. Patients now going into group health plans are unaffected. Optometrists have not regained this lost income.
2. Patients now unable to afford service will still be in the same position.
3. The patients who do enter the plan are already the optometrists' patients. The optometrist gets no new income, but he has taken a third party, the insurance company, into the doctor-patient relationship. All that has been added is the red tape of an insurance company. The case with labor unions is similar. Labor is, for the most part, optometric material at present. The only new part of the plan would be that management would pay the optometric bill for their workers in lieu of a pay raise, and the optometrist, instead of dealing with individual patients, would be dealing with major corporations—much better able to hammer his fees down to rock bottom. Without laboring the point, it seems clear that no new optometric income is involved but there is a chance of a loss. Transferring the coins from the left trouser pocket to the right, never made anyone richer—and the occasionally dropped coin only makes him poorer.

It is interesting to note that arguments for the two conditions are identical—and this is important. Optometric income and good eye care are intimately tied to each other. The public will benefit from optometrists giving the best they have—in time, in knowledge, in service, and in materials. This cannot be done cheaply, and the weakness of all of the voluntary plans is that they flaunt high ideals but are merely fronts for price-cutting. Group health plans are only, in mass organization, the "quickie" examination and minimum service to get "just barely acceptable quality" glasses on the patient and the patient ushered out—and this has been with us for many years. The sole difference is that the optometrist is getting paid only what he earns by his "quickies" and the clinic or an optician pockets the profits accruing from the sale of glasses. *And* the patient received poor care. In the final analysis, it is in the cards to get only what one pays for.

There is another danger for optometry in the plan of including refraction in an insurance policy. It has been mentioned that refraction is an uninsurable item because of the universal need for the service. However, this need not be the case provided there is a method of screening which will differentiate those who are decidedly in need of a

refraction from those who may need visual care. Such a screening procedure could be as simple a method as having the permission to have a refraction dependent upon the opinion of a general medical practitioner. It is the author's fear that the insurance companies, finding that everyone who is insured is taking advantage of the refractive services will place a restriction upon the service, and this restriction will read "only when ordered by a physician." This would immediately place the program in a different light in the eyes of optometrists who can readily recognize the difficulties which might ensue if such a course were to be followed. We feel that the insurance companies may accept a plan for refraction for a time, but that as soon as they realize that they are dealing with a universally needed item, and, hence, one which cannot be insured against, that they will seek means of making it insurable by making it less universally supplied. One method of doing this has been suggested, namely, making the general medical practitioner decide upon the necessity for refraction. Clearly this will not benefit optometry nor the patients. Optometry will be in the very unenviable position of having taken their last source of patients and placed many of them outside the realm of optometric services. Yet, for refraction to be insured, some such plan will have to follow, even if it is not in the original scheme. We fear that those proposing the inclusion of refraction in insurance policies have not thought the thing through to the time when the insurance companies suddenly realize that they are insuring something that is no more insurable than a routine physical examination—an item which all policies have carefully avoided.

At the risk of repetition, the arguments against pressing for inclusion of refraction in health policies may be summarized:

(a) Such a plan does not affect the basic problem, that of inferior eye care at a price being offered both by private companies and by health plans.

(b) The plan will, if it has any effect at all, tend to reduce the quality of the service offered. Fees set by third parties tend to become maximum fees, and the service is reduced to fit the fee. This has been the trend in all other phases of the picture, and there is no reason to believe that it will be different here.

(c) Persons who need and cannot afford care are unaffected. Those who are involved are already optometric patients receiving good care at fair prices. This situation for these people cannot be improved. They are getting and paying for the best; to group them together and place their fate in the hands of a third party, either insurance company

or labor union, cannot benefit them and can hurt both these patients and optometrists.

(d) Because refraction is basically uninsurable, it will soon become obvious to the insurance companies that a mistake has been made. The steps which will be necessary to make refraction insurable will necessitate making it a less universal procedure by screening out a segment of the population. Neither the patient nor the optometrist will benefit by this.

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TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ACADEMY LUNCHEON AT SEATTLE CONGRESS OF A.O.A.

Members of the Academy and guests will meet at the annual Congress of the A.O.A. at Seattle for their traditional Academy luncheon, Tuesday, June 22, in Parlor A, Olympic Hotel. Academy members planning to attend the Congress should arrange to hold Tuesday noon for this special luncheon. All are urged to be present. President Morgan and Secretary Koch will be on hand to greet the members and their guests.

GILES SPEAKS AT NEW YORK ACADEMY MEETING

The March meeting of the New York Academy of Optometry was held jointly with the New Jersey Chapter, American Academy of Optometry, on Tuesday, March 16, at the Midston House, New York City.

The speaker and guest of honor was G. H. Giles, F.B.O.A. (Hons.), F.A.A.O., D. Orth, Secretary of the British Optical Association and senior Orthoptist for the London Refraction Hospital. His subject was "The Impact of the British National Health Service on the Ophthalmic Professions." Mr. Giles was here on the invitation of the Association of Schools and Colleges of Optometry. His subsequent tour included all member institutions in the United States and Canada.

SAN FRANCISCO BAY AREA CHAPTER ELECTS OFFICERS

New officers of the San Francisco Bay Area Chapter, American Academy of Optometry, elected at the meeting of March 4 held at the University of California School of Optometry were Dr. Darrell B. Carter, Chairman; Dr. Arthur B. Emmes, Vice-Chairman; Dr. Gordon G. Heath, Secretary-Treasurer; Dr. Jack T. Hobson, Member of the Executive Council; and Dr. Merton C. Flom, Chairman of the Committee on Admittance. Outgoing Chairman is Dr. Robert F. Harrigan.

The program for the Western Regional Meeting of the American Academy of Optometry, scheduled for April 10-11 in Berkeley, was reviewed and for comparative interest, the program and events of the meeting of the A.A.O. held in Chicago last December were reported and discussed by Drs. Meredith W. Morgan, Jr. and Merton C. Flom.

Speaker of the evening was Meredith W. Morgan, Jr., Ph.D., Professor of Physiological Optics and Optometry at the U. C. School of Optometry and President of the American Academy of Optometry, who presented a paper, "Detailed Haploscopic Studies on One Subject." This was the study Dr. Morgan had reported at the Chicago meeting, and dealt primarily with his attempts to discover a physiological reserve of accommodation by careful measures of changes in his own ACA ratio and accommodative amplitude during recovery from cycloplegia.

Ralph S. Minor, Ph.D., Dean Emeritus of the U. C. School of Optometry, was elected to honorary membership in the Chapter.

ACADEMY COMMITTEE APPOINTMENTS FOR 1954

Dr. Meredith W. Morgan, Jr., president, announces the following committee appointment for 1954.

COMMITTEE ON PUBLICATIONS

Dr. Morton Abram, Chicago, chairman; Dr. Robert E. Bannon, Southbridge and Dr. Kalvin Blodgett, Stillwater, Minnesota.

COMMITTEE ON ADMITTANCE—NORTH CAROLINA CHAPTER

Dr. John T. Campbell, Washington, Chairman; Dr. T. E. Donoghue, Wilson, and Dr. T. E. Holleman, Winston-Salem.

CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

INDIANA OFFERS GRADUATE WORK IN PHYSIOLOGICAL OPTICS

The Indiana University Graduate School has approved the offering of graduate work leading to the degree of Master of Science in Physiological Optics. It is planned that as the program develops the degree of Ph.D. in Physiological Optics will also be offered.

This program is intended to advance the knowledge in the sciences that relate to vision and seeing, collectively referred to as physiological optics, and is designed primarily for graduates of optometry curricula wishing to prepare themselves for teaching and research in the field of vision. The principal career opportunities for recipients of graduate degrees in physiological optics are in optometry schools, visual research centers, the ophthalmic industry, and specialized optometric practice.

Every application for entrance to graduate study will be considered individually by the Director of the Division of Optometry. The minimum prerequisites shall be sixty semester hours of liberal arts credit and a degree representing completion of a five year curriculum in optometry, with a combined grade point average of not less than 2.00 (A = 3.00, B = 2.00, C = 1.00). Applicants not fulfilling these requirements may be admitted only with the special consent of the Director of the Division of Optometry and the Dean of the Graduate School, and may be required to take specified courses in the regular curriculum of the Division of Optometry.

The degree of Master of Science in Physiological Optics requires a minimum of thirty semester hours of credit not less than twenty of which shall be earned in the graduate program in physiological optics. A thesis is required unless the supervisory committee, after consultation with the student, elects to substitute the requirement of a reading knowledge of a foreign language. All of the regular Graduate School requirements for the degree Master of Science must be met.

Inquiries concerning admission to this program should be addressed to the Dean of the Graduate School, Indiana University, Bloomington, Indiana.

ASSOCIATION OF MILITARY OPTOMETRISTS TO MEET

The annual meeting and election of officers of the Association of Military Optometrists of the United States will take place in Seattle

during the 57th annual Congress of the A.O.A. The meeting is scheduled for Sunday morning, June 20 at 10:00 A. M. in Parlor A of the Olympic Hotel. Dr. Eugene W. Strawn, Freeport, Illinois, is Secretary of the Association.

NEWS BRIEFS

The annual Practitioners Educational and Clinical Conference of the Pennsylvania State College of Optometry will be held June 7-11, 1954, at the College in Philadelphia. . . . The Association of Ophthalmic Opticians of Ireland is planning a four day educational conference in Dublin in June, 1955. This meeting will immediately precede or follow the 1955 meeting of the International Optical League also scheduled for Dublin. Optometrists from the United States and Canada are invited to participate in these meetings while on their 1955 European vacations. . . . In the Special Report in this issue, Dr. Monroe J. Hirsch presents some interesting comments on why ocular refractions fail to fit into regular health insurance programs. His review of this subject also makes clear the opposition of dentistry towards inclusion in these same programs. . . . If you have missed the showing of the new B.V.I. film, "The Magic Pathway," be sure to catch it when it is next shown by your local or State association. By any yardstick this new film is tops. . . . Univis has a new trifocal (continuous vision) lens. It is called the Nu-Line 7 CV. . . . Bausch & Lomb also have a new series of trifocal lenses with graduated intermediate powers to meet various requirements. . . . The Ohio State Optometric Association will hold its annual meeting in Akron, Hotel Mayflower, October 17-18. . . . Dr. Fred W. Sutor, Philadelphia, will be the speaker at the joint meeting of the Virginia and West Virginia Optometric Associations at the Greenbrier Hotel, White Sulphur Springs, West Virginia, May 27-29. . . . The clinical work done on subnormal vision cases at the School of Optometry, University of California under the supervision of Dr. Meredith W. Morgan, Jr., faculty member and President of the Academy, was reviewed by NEWS WEEK during March. . . . Dr. William Smith, Massachusetts College of Optometry, spoke before the March meeting of the Southeast Florida Optometric Association at Miami on orthoptics and visual training. . . . The Iowa Optometric Association will hold its annual meeting at the Hotel Savery, Des Moines, May 2-4. Dr. Sylvester K. Guth, Nela Park, Cleveland, Ohio, will be the speaker. . . .

BOOK REVIEW

FUSIONAL PHENOMENA IN ANOMALOUS CORRESPONDENCE. Ulf Hallden. Upsala, Sweden. 93 pages, board covers, $5.00. 1953.

This is a report (in English translation) of an investigation carried out on nine cases of strabismus with anomalous correspondence, at the Ophthalmic Clinic of the University Hospital, Upsala. The findings of a systematic and quantitative study are presented in excellent detail.

The techniques employed were relatively simple. The subject wore a pair of polaroids with their axes of orientation at right angles to each other while he fixated with one eye a point in the center of an aluminized tangent screen. The after-image of an incandescent filament previously fixated by the squinting eye was located on the tangent screen, first with a projected spot polarized so as to be visible only to the fixing eye, and second with a projected spot polarized so as to be visible only to the squinting eye. The former gave a direct measure of the angle of anomaly, and the latter gave a direct measure of the objective angle of squint.

Then, two non-similar objects were projected on the screen by separate projectors with oppositely oriented polarization axes so that one of the patterns was seen by one eye and the other pattern by the other eye. The positions of the objects when the patient reported superimposition gave a measure of the subjective angle of squint.

Each of these three measurements was taken frequently during prolonged periods, both with and without prisms in front of the eyes.

In the day-to-day and hour-to-hour trend studies, the author observed significant co-variation between the objective angle of squint and the angle of anomaly. One is impressed by the observation that in the five cases without history of surgery the subjective angle was consistently zero in the special technique employed, documenting the author's theory that non-harmonious correspondence obtained by the more conventional haploscopic methods is a testing artefact.

The wearing of prism correction for periods of approximately a half hour variously gave rise to changes in the objective angle of squint, changes in the angle of anomaly, and changes in the subjective angle. These changes occurred separately as well as combined with each other in various ways. Most typical was a co-variant adjustment

of the subjective and objective angles of squint to compensate for the prism, with no change in the angle of anomaly.

The prism experiments and the tropia measurements were carried out in both the vertical and horizontal meridians. Supplementary clinical and refractive details are included for each of the patients, though these do not include information concerning the accommodation-convergence relationships. The latter omission limits the interpretation that might otherwise be applied to some of the phenomena reported.

The report is thorough in its review of previous related articles and in its discussion of theories of squint, fusion, and anomalous correspondence. The practical application of the investigation is hardly forthcoming, but its contribution to our knowledge of squint and the importance of the reported findings to squint theory make it an essential reference to the teacher and researcher.

HENRY W. HOFSTETTER

DIVISION OF OPTOMETRY
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ANNOUNCEMENT

SEATTLE A.O.A. CONGRESS REGISTRATION

Optometrists who are members and are planning to attend the 57th annual Congress of the American Optometric Association in Seattle, Washington, June 20-23, should now secure their advance Congress registration and their hotel reservations. The registration fee for members is $25, wives $15, and guests (children or other lay guests) $12.50. Your check covering these registration fees and your requirements for hotel reservations should be sent to Dr. George Winston, 410 Union Street, Seattle 1, Washington, at this time.

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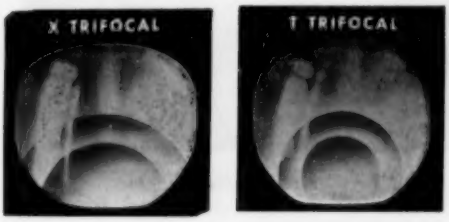

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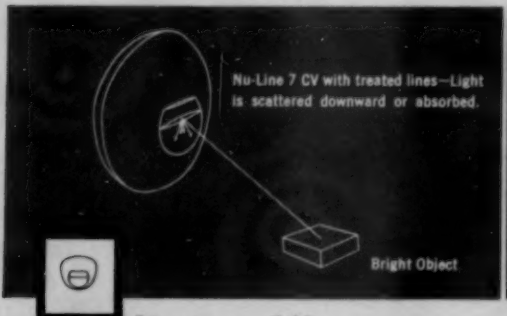

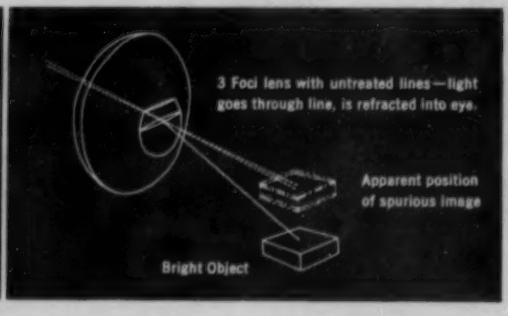
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